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SOUTHEASTERN MICHIGAN WASTEWATER MANAGEMENT SURVEY SCOPE STUDY.--ETC(U)
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SOUTHEASTERN MICHIGAN
WASTEWATER MANAGEMENT
SURVEY SCOPE STUDY

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Chapter I

PURPOSE OF EVALUATION

Evaluation is basically a decision making tool which allows for consideration of factors not considered in engineering design. A comprehensive evaluation would include not only an evaluation of the ability of a system to achieve its primary goals but also an evaluation of the effect that the system would have on the surrounding area and how that system would contribute to local, regional and national objectives. Consideration of such factors as economic, social, ecological, aesthetic and hygienic impacts would be useful in anticipating problems which could arise due to implementation of a plan. Early diagnosis of problem areas would thus allow design changes prior to implementation of a plan. The evaluation would finally be used to narrow the range of plans and ultimately to select the plan which in the judgment of the decision makers contributes the most to local, regional and national objectives.

Chapter II

EVALUATION METHODOLOGY

During the Feasibility Study it was recognized that by breaking the evaluation project into several functional areas, use could be made of many locally available individuals having both an expertise in a specific area of concern and a familiarity with the study area. The combination of expertise and familiarity with the area was considered especially important since it was recognized that in many cases the data required for a conclusive evaluation would not be available and thus the judgment of the evaluator would have to be relied upon heavily. The functional areas selected for evaluation were: ecological, hygienic, economics, agricultural economics, social and aesthetics.

Evaluations were begun during the early stages of plan formulation and design. This served two purposes: (1) it allowed the evaluators a lead time in accumulating base data; and (2) it allowed consultation with evaluators during plan formulation and design. The continuous feedback into plan formulation and design activities made it possible to incorporate many changes into the designs which might otherwise have been overlooked until final evaluations were made. As an example--the ecological evaluators played an important roll in selection of the design parameters used for the stormwater retention basins. The following is a list of the participants in the evaluations:

ECOLOGICAL

Institute of Water Research, Michigan State University

Project Participants:

Thomas G. Bahr -- Assistant Director, Institute of Water Research, Project Coordinator (Limnology and Pollution Biology)

Robert C. Ball -- Director, Institute of Water Research, (Limnology and Pollution Biology)

James O. Corlett -- Research Associate, Institute of Water Research, (Project Engineer - Mass Balance Studies)

Frank M. D'Itri -- Assistant Professor, Institute of Water Research, (Project Chemist - Heavy Metals)

Richard A. Cole -- Research Associate, Institute of Water Research (Lake Erie Limnology)

Marvin E. Stephenson -- Associate Professor, Institute of Water Research, (Environmental Engineering)

Robert K. Johnson -- Research Assistant, Institute of Water Research, (Data Acquisition and Processing)

Boyd G. Ellis -- Professor, Department of Crop and Soil Sciences, (Consultant on Soil Chemistry - Phosphorus)

Arthur R. Wolcott -- Professor, Department of Crop and Soil Sciences, (Consultant on Soil Nitrogen Dynamics)

Bernard D. Knezek -- Associate Professor, Department of Crop and Soil Sciences (Consultant on Soil Chemistry - Heavy Metals)

A. Earl Erickson -- Professor, Department of Crop and Soil Sciences, (Consultant on Soil Physics)

Niles R. Kevern -- Professor and Chairman, Department of Fisheries and Wildlife, (Consultant on Stream Ecology)

Howard E. Johnson -- Associated Professor, Department of Fisheries and Wildlife, (Consultant on Pesticides and Toxic Materials)

Clarence D. McNabb -- Professor, Department of Fisheries and Wildlife, (Consultant on Aquatic Botany)

Walter H. Conley -- Assistant Professor, Department of Fisheries and Wildlife, (Consultant on Terrestrial Ecology)

Harold H. Prince -- Associate Professor, Department of Fisheries and Wildlife, (Consultant on Waterfowl Ecology)

HYGIENIC

John J. Gannon -- Professor of Public Health Engineering, School of Public Health, University of Michigan, Project Coordinator

Kenneth W. Cochran -- Professor of Epidemiology, School of Public Health, University of Michigan (virology)

Ralph G. Smith -- Professor of Environmental and Industrial Health, School of Public Health, University of Michigan (Toxicology and Atmospheric Emissions)

Kerby F. Fannin -- Graduate Fellow, School of Public Health, University of Michigan.

ECONOMICS AND SOCIAL

Paul M. Reid -- Private consultant formerly with the Southeastern Michigan Council of Governments

AGRICULTURAL ECONOMICS

Economic Research Service, U. S. Department of Agriculture

Primary Participant -- Lee A. Christensen

AESTHETICS

Staff -- Planning Branch, Engineering Division
Detroit District, U. S. Army Corps of Engineers

Each evaluator was given the task of developing an evaluation methodology consistent with his particular field. To aid in developing methodology, evaluators were fully briefed on the background of the study, its objectives, and the type of systems which could be expected for evaluation. Evaluators were also given two guidance documents for use in methodology formulation:

> "Revised Guidelines for the Assessment and Measurement of Impacts and their Evaluation to the Objectives of the Wastewater Management Program", Department of the Army, Office of the Chief of Engineers, 18 June 1971.

and

> "Wastewater Management Program Study Procedure", U. S. Army Corps of Engineers, Office of the Chief of Engineers, 1 May 1972 (also preliminary draft dated 8 November 1971).

The proposed methodology was reviewed by the Detroit District staff and modified as necessary to conform with study objectives.

The evaluators were given data as it became available during the plan formulation and design phases. Upon receipt of all information pertinant

to the preliminary alternatives (see Chapter VI) the evaluators prepared reports in which analysis of both the technology employed and the system as a whole was presented. A list of those documents follows:

ECOLOGICAL ASSESSMENTS FOR
WASTEWATER MANAGEMENT IN SOUTHEASTERN MICHIGAN
Institute of Water Research, Michigan State University

LAND DISPOSAL OF WASTEWATER - AN ASSESSMENT
OF ITS IMPACT ON THE AGRICULTURAL ECONOMY
Economic Research Service, Natural Resource
Economics Division, U. S. Department of Agriculture

ECONOMIC ASSESSMENT - SOUTHEASTERN MICHIGAN WASTEWATER
MANAGEMENT STUDY - Paul M. Reid

HYGIENIC ASSESSMENTS OF ALTERNATIVE SYSTEMS OF
WASTEWATER MANAGEMENT IN SOUTHEASTERN MICHIGAN
Kerby F. Fannin, John J. Gannon, Kenneth W. Cochran
and Ralph G. Smith

AESTHETIC ASSESSMENT - SOUTHEASTERN MICHIGAN
WASTEWATER SURVEY SCOPE STUDY
DETROIT DISTRICT STAFF

SOCIAL ASSESSMENT - SOUTHEASTERN MICHIGAN WASTEWATER
MANAGEMENT SURVEY SCOPE STUDY - Paul M. Reid

In order to arrive at a total evaluation of the system, it was then necessary to compile the data from the individual evaluators. This function was performed by the District staff. Chapter V of this report is a summary of the pertinent points as they apply to the technology to be

employed. Chapter VI summarizes the preliminary alternatives and a summary of the comments made by the evaluators pertinent to each alternative.

A large part of the evaluations were qualitative rather than quantitative. In some cases, such as the potential hygienic impacts, the subject did not lend itself to quantification. In other cases such as the identification of family and business displacement, the system design had not been sufficiently detailed to allow quantification.

Following release of the preliminary alternatives to the public, it was decided that the land irrigation system, as presented, would not be acceptable to the agricultural community. Subsequently, a new system of land irrigation was developed. Through discussion with evaluators, it was found that previous environmental evaluations would be valid for evaluation of the new system. It was necessary to evaluate the new system in the areas of social, economics, agricultural economics, hygienics, and aesthetics. Those evaluations were done by the same groups or individuals previously discussed and appear at the end of each of the reports.

Based on the evaluations performed, the preliminary alternatives were modified to form three representative plans for final consideration. Those plans appear in Chapter IX.

Chapter III

PLANNING OBJECTIVES

Planning objectives pertaining to wastewater management in Southeastern Michigan have been determined by Federal, state, regional, and local agencies. These provide the basis for plan formulation, impact assessment, and evaluation processes.

Objectives

The general goals of the U.S. Canadian Great Lakes Water Quality agreement are to restore and enhance the water quality of the International Great Lakes and to prevent further pollution as a result of population growth, resources development, or increased water use.

The agreement describes some general water quality objectives that have been characterized as the five freedoms of water quality. These state that the waters of the Great Lakes should be:

1. Free from substances that will settle to form putrescent or otherwise objectionable sludge deposits or that will adversely affect aquatic life or waterfowl;

2. Free from floating debris, oil, scum, or other floating materials in amounts sufficient to be unsightly or deleterious;

3. Free from materials producing color, odor, or other conditions in such a degree as to create a nuisance;

4. Free from substances in concentrations that are toxic to human, animal, or aquatic life; and

5. Free from nutrients in concentrations that create nuisance growths of aquatic weeds and algae.

In addition to these general goals and objectives, the agreement spells out eight specific water quality objectives for the Great Lakes. This list includes specific limits covering microbiology, dissolved oxygen, total dissolved solids, taste and odor, pH iron phosphorous, and radioactivity. It also specifies five interim objectives to be used until more specific limits can be determined. The items covered include temperature, mercury and other toxic heavy metals, persistent organic contaminants, settleable and suspended materials, oil petrochemicals and immiscible substances. A non-degradation clause is also included which provides for further study on 18 specific constituents or substances.

Finally, the agreement outlines some specific program objectives and guidance. It specifies that programs and measures for Great Lakes water quality improvement shall either be completed or in the process of implementation by December 31, 1975. Some of the specific areas that are to be incorporated into water quality programs include control of eutrophication and pollution from municipal sources, industrial sources, agricultural, forestry, and other land use activities, shipping activities, dredging activities and onshore and offshore facilities. In addition, the programs should provide for the development of a joint contingency plan and the identification and control of hazardous polluting substances.

Public Law 92-500 establishes goals, objectives, and programs for improvement of water quality in the United States. The law proclaims two general goals for the Nation:

1. To achieve wherever possible by July 1, 1983, water that is clean enough for swimming and other recreational uses, and clean enough for the protection and propagation of fish, shellfish, and wildlife.

2. And by 1985 to have no discharges of pollutants into the Nation's waters.

The new Amendments also provide several general and specific objectives relating to water quality, comprehensive regional planning, and resource conservation. Those relating to water quality are:

1. the discharge of toxic pollutants in toxic amounts shall be prohibited,

2. that public participation in water quality programs shall be encouraged, and

3. that water quality programs shall emphasize the reduction and elimination of duplication of effort.

Those relating to comprehensive regional planning are:

1. that wastewater management planning be carried out on an areawide basis wherever possible,

2. that wastewater management programs be designed to control and treat all sources of wastes including point sources, non-point sources, and in-place or accumulated sources, and

3. that wastewater management plans must be developed for waste treatment needs in the study area for a 20-year period.

Those relating to resources conservation are:

1. to encourage waste treatment management which results in construction of revenue producing facilities providing for the recycling of potential sewage pollutants through the production of agriculture, silviculture, or aquaculture products and the reclamation of wastewater, and

2. to encourage waste treatment management which results in integrating facilities for sewage treatment and recycling with facilities to treat, dispose of, or utilize other industrial and municipal waste.

Objectives relating to wastewater have been proposed by state, regional and local agencies. Many of these goals and objectives are similar to the ones noted above and to each other. The following summary is a general list of these for the area.

1. To protect the surface waters of Southeastern Michigan for water supply, recreation values, and fish, wildlife and other aquatic life.

2. To use existing systems as a base for implementing a centralized water supply and sanitary sewer system.

3. To control the critical combined storm and sanitary sewer overflows through retention to reduce spills into receiving waters.

4. To eliminate industrial waste discharge to streams by requiring pretreatment and discharge to a regional interceptor system.

5. To formulate and maintain a land use development pattern that will provide the people of the region with areas that can readily be served by networks of necessary public utilities, such as, water supply, sanitary sewers and treatment plants, and storm drainage.

6. To eliminate the discharge of wastewater to inland water systems in Michigan.

These international, national, state, regional, and local objectives together with the specific study authorities formed the basis for developing the six basic Southeastern Michigan Wastewater Management Study objectives.

They are:

1. To provide a range of potentially implementable regional wastewater management plans for Southeastern Michigan.

2. To develop these plans in harmony with the existing facilities and short range plans of the governmental agencies within the region.

3. To include in the objective development of these plans, alternative technical systems for the control of pollution from municipal, industrial, and urban stormwater runoff sources.

4. To develop these technical systems to approach with the best available technology the 1985 "no discharge of pollutants" goal of the Federal Water Pollution Control Act Amendments of 1972.

5. To provide an alternative regional wastewater management plan to achieve a lesser effluent quality standard as defined by the State of Michigan.

6. To evaluate all of these regional wastewater management plans in terms of economics, social, cultural, aesthetic, institutional, and environmental considerations and display these impacts.

Chapter IV

REGIONAL CHARACTERISTICS

The southeastern Michigan study area covers all or part of nine counties and has a total land area of 6240 square miles. The area had a population of 4,851,348 people in 1970 which is expected to increase to 6,291,300 by 1990. The area is drained by seven major river basins: the Black, Pine, Belle, Clinton, Rouge, Huron, and Raisin Rivers. The rivers all drain into the river network connecting Lake Huron to Lake Erie, i.e. the St. Clair River, Lake St. Clair and the Detroit River.

The climate in S.E.M. is strongly influenced by the Great Lakes. The average yearly temperature varies from 46.7°F to 108°F. Precipitation is distributed fairly uniformly through the year and averages 31 inches annually. Extremes of rainfall recorded over a 32-year period were 19.84 inches in 1963 and 41.44 inches in 1950.

Michigan is blessed with a fortunate combination of meteorology and topography which create an unstable (turbulent) meteorological condition. As a result of this instability, inversion conditions are infrequent and of short duration. It is under conditions of inversion that pollutants accumulate in the air above a community, leading to the formation of photochemical smog and increasing incidence of problems associated with air pollution.

The southeastern Michigan area is rich in water resources. The Great Lakes System provides an abundance of fresh water from Lake Huron, though the St. Clair River, Lake St. Clair and the Detroit River, into Lake Erie, as indicated by an average flow in the Detroit River of 120 billion gallons per day. In addition there are approximately 750 lakes of more than one

acre in size of which approximately 50 are greater than 200 acres. The seven principal tributaries average from 50 to 80 miles in length and serve as water supplies for several inland communities.

Water quality is generally good in tributary river headwaters and up-river of Detroit in the Great Lakes connecting channel. Most of the water supplied to the area is taken from Great Lakes surface waters.

The geology of the area consists mostly of broad layers of limestone, dolomite, shale, and sandstone which dip toward the northwest. Much of the rock is characterized by crevices and channels which serve as excellent ground water sources. 100 to 300 feet of glacial drift covers the bedrock over most of the area.

The topography of the area within twenty to thirty miles of the St. Clair River, Lake St. Clair, the Detroit River and Lake Erie is quite flat, since it was once the bottom of a glacial lake. River flows are slow in this area. Soils are favorable for farming although drainage problems are common. West of this area, glacial moraines of clay, sand and gravel form hills 200 to 300 feet high. Small, rapidly flowing rivers form the headwaters of the major rivers of southeastern Michigan. Although soils are suitable for farming, slopes in the area are generally too steep.

The core economic activity of the area for some decades has been manufacturing, with automotive production the major component. Although the Detroit Metropolitan Area persists as the center of employment; urbanization has been spreading from the central city to the surrounding communities and townships resulting in a dispersed pattern of economic establishments such as manufacturing plants, office complexes and shopping centers. Similar trends have been experienced in the other urban centers of the area: Pontiac, Mount Clemens, Port Huron, Ann Arbor, Ypsilanti, Adrian and Monroe.

Although manufacturing continues to account for a major portion of the employment; the percentage of total employment engaged in manufacturing has been declining over the past two decades in favor of non-manufacturing employment. Employment in agriculture, forestry and fishing has declined 50 percent since 1950 while food processing employment has declined 24%.

Chapter V

EVALUATION OF SYSTEM COMPONENTS

Before one can evaluate a regional wastewater management system, one must first evaluate those components of which such a system would be composed.

A regional wastewater management system would consist of many small community collection systems connected to a larger system of interceptor sewers leading eventually to one or a number of treatment facilities. The collection systems may be designed either as a combined storm and sanitary sewer or with separate systems for storm runoff and wastewater (sanitary wastewater and pre-treated industrial waste.).

In this study, three major areas lend themselves to individual evaluation: the process by which wastewater would be renovated, the method utilized for treatment and ultimate disposal of wastewater solids, and the system used for collection, temporary storage and transmission of storm runoff.

Wastewater Treatment Methods

A variety of methods may be employed in a treatment facility. The present goal for the State of Michigan is to achieve the equivalent of secondary treatment with 80 percent phosphorus removal. In most cases this would be an activated sludge type secondary plant with a chemical clarification for phosphorus reduction. Additional treatment would be required for plants located on inland streams especially when the stream is used as water supply by downriver communities.

In this study three, more advanced methods of wastewater treatment have been investigated: advanced wastewater treatment (AWT), independent

physical-chemical treatment (IPCT) and land irrigation treatment.

The advanced wastewater treatment scheme selected for this study consists of secondary treatment by the activated sludge process, followed by a second stage activated sludge process for conversion of ammonia nitrogen to nitrate nitrogen. These processes are followed by additional physical and chemical processes (i.e. lime clarification, filtration, carbon adsorption and chlorination) to provide further treatment. The treatment scheme selected for independent physical-chemical treatment replaces the activated sludge process with more extensive use of physical and chemical processes (i.e. high lime clarification, carbon adsorption, break-point chlorination and filtration).

The third treatment method investigated would make use of soil and crops to renovate wastewater. Raw wastewater would first be treated to an equivalent of secondary treatment in aerated lagoons. The secondary effluent, following disinfection, would be applied to the land in a farm type operation. Phosphorus and heavy metals remaining in the secondary effluent would be adsorbed by the soils and nutrients would be taken up by crops.

Several factors must be considered in the selection of a wastewater treatment method. Table 1 outlines some of the more important considerations.

Sludge Handling Methods

All wastewater treatment methods investigated would produce sludges of some type. The method by which sludges would be handled or disposed of must also be weighed in the evaluation of a treatment method. Although sludge characteristics would vary somewhat with different treatment methods, alternatives for disposal are limited. The three methods investigated were sanitary landfill of partially dry sludge, incineration (or in the

TABLE I

FACTORS TO BE CONSIDERED IN SELECTING A WASTEWATER TREATMENT TECHNOLOGY

	SECONDARY TREATMENT & 80% PHOSPHORUS REMOVAL	ADVANCED WASTEWATER TREATMENT	INDEPENDENT PHYSICAL-CHEMICAL TREATMENT	LAND IRRIGATION WASTEWATER TREATMENT (TOTAL ACQUISITION OF LAND)
I. EFFLUENT QUALITY	State effluent water quality requirements for inland plants: BOD_5 . . . . . 4.0 mg/l BOD_{20} . . . . . 8.0 mg/l Suspended Solids . . . 15.0 mg/l Phosphorus Removal 80% NH_3 - N . . . 0.5 mg/l Plants discharging to the St. Clair R. the Detroit R. and Lake Erie will provide a minimum of secondary treatment and 80% phosphorus removal. The resulting effluent quality would be as above except NH_3 - N would be 8-12 mg/l. Some degree of removal of heavy metals synthetic organics and pesticides would be achieved.	Average effluent water quality: BOD_5 . . . . . 1 mg/l COD . . . . . 10 mg/l Suspended Solids . . . 1 mg/l Phosphorus . 0.1 mg/l NH_3 - N . . 0.3 mg/l Total N . . 1.5 mg/l Heavy metals, synthetic organics and pesticides would be reduced to trace levels in the effluent.	Average effluent water quality: BOD_5 . . . . . 4 mg/l COD . . . . . 10 mg/l Suspended Solids . . . 2 mg/l Phosphorus . 0.1 mg/l NH_3 - N . . 0.2 mg/l Total N . . 1 mg/l Heavy metals, synthetic organics and pesticides would be reduced to trace levels. Chloride concentrations would increase by 70-120 mg/l.	Average effluent water quality: BOD_5 . . . . . 0.5 mg/l COD . . . . . 3.5 mg/l Suspended Solids . . . 0.25 mg/l Phosphorus . . 0.1 mg/l Total N . . . 3.0 mg/l Heavy metals, synthetic organics and pesticides would be reduced to trace levels in the effluent.
II. RESOURCE DEMANDS	Lime, aluminum, iron salts and polymers may be used both for phosphorus removal and sludge conditioning. 85 pounds of chlorine would be required per million gallons for disinfection. Power requirements would be slightly greater than for a secondary plant. Fuel requirements would be minimal.	Materials required would be: Lime - 1570 pounds/MG Chlorine - 85 pounds/MG Methanol - 290 pounds/MG Activated carbon - 10 pounds/MG Power requirements would double that of a typical secondary plant. 8-10 million BTU of fuel would be required per ton of reclaimed lime (lime manufacturing required 4.5-8 million BTU per ton).	Materials required would be: Lime - 1500 pounds per million gal. Chlorine - 1000 pounds/million gal. Activated carbon - 35 pounds/MG Power requirements would be less than that required for a typical secondary plant. 8-10 million BTU of fuel would be required per ton of reclaimed lime (lime manufacturing requires 4.5-8 million BTU per ton).	85 pounds of chlorine would be required per million gallons for disinfection. Power requirements for aerated lagoons would approach those of a secondary plant. Additional power would be required for transmission to lagoon and land sites depending on distance and elevations. Phosphorus, nitrogen and other plant nutrients would be returned to the environment during irrigation. Fuel requirements would be minimal.
III. SLUDGE PRODUCTION	Sludge produced would be a mixture of chemical and organic sludges. Quantity and composition of sludge would depend upon the process and chemicals employed.	0.8 dry tons/MG - organic sludge 1.1 dry tons/MG - lime sludge	1.5 dry tons/MG - lime & organic sludge 1.5 dry tons/MG - calcium rich sludge	0.8 dry tons/MG - organic sludge
IV. LAND REQUIREMENTS	Minimum land requirements for a secondary activated sludge plant range from 5 acres for a 1 MGD, 10 acres for a 10 MGD to 36 acres for a 100 MGD plant.	Minimum land requirements for an AWT plant range from 13 acres for a 1 MGD, 26 acres for a 10 MGD to 90 acres for a 100 MGD plant.	Minimum land requirements for an IPCT plant range from 3.5 acres for a 1 MGD, 9 acres for a 10 MGD to 34 acres for a 100 MGD plant.	Treatment and storage lagoons would require approximately 30 acres/MGD. Land required for irrigation would depend on soil type and permiability: Sandy loams . . . 200 - 300 acres/MGD Sand . . . . . 300 - 550 acres/MGD Loamy clay . . . 900 -1400 acres/MGD

V. HYGIENIC CONSIDERATIONS A. PUBLIC HEALTH	Current practices of sub-chlorination would not be effective against many infectious agents. Possible aerosol transmission of infectious agents, including viruses and fungi from open aeration tanks. Dangers involved with transportation and handling of large quantities of liquid chlorine; could be avoided by on site generation of chlorine or ozone.	The sequence of treatment processes with break-point chlorination should yield a relatively pathogen-free effluent. Possible aerosol transmission of infectious agents, including viruses and fungi from open aeration tanks. Dangers involved with transportation and handling of large quantities of liquid chlorine; could be avoided by on site generation of chlorine.	The sequence of treatment processes with break-point chlorination should yield a relatively pathogen-free effluent. Dangers involved with transportation and handling of large quantities of liquid chlorine; could be avoided by on site generation of chlorine.	The spray irrigation system proposed should effectively reduce or eliminate the threat of infection via specific biological agents in the effluent. Possible aerosol transmission of infectious agents, including viruses and fungi, from aerated lagoons and irrigation equipment. Potential concentration of heavy metals in plant tissues and subsequent danger if allowed into the food chain. Potential dangers if irrigated areas are not properly managed: - release of adsorbed heavy metals to groundwaters if soils are allowed to become acidic. - airborne transmission of fungal spores if irrigated soils are allowed to dry. - mosquito breeding if irrigated water is allowed to pond. - nitrate accumulation in groundwaters if plant nitrogen uptake capacities are exceeded. Dangers involved with transportation and handling of large quantities of liquid chlorine; could be avoided by on site generation of chlorine or ozone.
B. OCCUPATIONAL HEALTH	Danger of infection of workers especially around aeration basins and areas where unprocessed sludges are handled. Danger to workers in areas of chlorine and lime use, and all poorly ventilated areas.	Danger of infection of workers especially around aeration basins and areas where unprocessed sludges are handled. Danger to workers in areas of chlorine and lime use and all poorly ventilated areas.	Minimum danger to workers handling sludges due to high pH of sludge. Danger to workers in areas of chlorine and lime use and all poorly ventilated areas.	Danger of infection of workers especially around aeration lagoons and sludge handling operations. Danger to workers in areas of chlorine use and poorly ventilated areas.
VI. MANPOWER REQUIREMENTS	Operating and maintenance manpower for a secondary plant may range from 2 men per MGD for a 10 MGD plant to less than 1 man per MGD for plants larger than 100 MGD.	Operation and maintenance manpower for an AWT plant would be of the same skill level as for IPCT and approximately double in number.	Operation and maintenance manpower for an IPCT plant would be similar in number to a secondary plant; however, higher skill levels would be necessary.	Operation and maintenance manpower for the lagoon treatment system would be fewer in number and of lower skill levels than for other methods of treatment. Manpower required for irrigation and farming operations would increase over the requirement for normal farming.
VII. POTENTIAL ECONOMIC IMPACTS	Treatment costs for secondary treatment with phosphorus removal range from approximately $0.20/1000 gal for a 10 MGD plant to less than $0.10/1000 gal for a large regional plant. Increased chemical consumption could cause increased local chemical manufacturing.	Treatment costs for advanced wastewater treatment range from approximately $0.65 per 1000 gal for a 10 MGD plant to $0.30 per 1000 gal for a large regional plant. Increased chemical consumption could cause increased local chemical manufacturing.	Treatment costs for IPC treatment range from approximately $0.50/1000 gal for a 10 MGD plant to $0.26/1000 gal for a large regional plant. Increased chemical consumption could cause increased local chemical manufacturing.	Wastewater treatment in aerated lagoons would cost somewhat less than in a secondary plant; however, additional costs which must be considered are: transmission to lagoon sites, lagoons for wastewater storage (3-4 mos.), transmission to irrigation sites, irrigation sites, irrigation facilities and collection and discharge facilities. Agricultural production should increase over production from non-irrigated land. Potential disruption of existing channels through which machinery, seed, and agricultural chemicals are supplied. Increase in production of roughage crop possibly displacing food crops or exceeding local demands for roughage.

case of lime sludges, recalcination) and land application. These are by no means the only methods but appeared the most viable for the southeastern Michigan area. Sanitary landfill of partially dewatered sludge would follow the procedures established for solid waste sanitary landfills. The sludge materials to be filled would be dewatered using filters or centrifuges, and filled in alternating lifts of sludge and earth. A fill area would be specially prepared and maintained to limit water percolation through the fill and prevent direct contact between fill materials and ground water aquifers.

In the incineration and recalcination processes, sludge is burned at temperatures of 1500-1700^{o}F in specially designed furnaces. Fuel would be required to maintain furnace temperature and insure complete combustion. Afterburners and emission control equipment would be a necessity to prevent excessive air emissions. Ash from incineration of wastewater sludges would be relatively inert and could best be disposed of by landfill. Lime clarification sludges, when recalcined, can yield good quantities of reusable lime.

Sludges can also be applied to lands and utilized for their agricultural value. Although raw sludge can be applied directly, initial decomposition may have toxic effects on plants. Digested sludges do not present that problem. Sludges may be plowed into the soil as a liquid or partially dry solid; or it may be applied in trenches as a partially dry solid. The final alternative allows high rates of initial application while the first two would require lower rates over a longer period.

Table 2 outlines some important items which must be considered in selecting a method. As can be seen from the table, none of the methods discussed would be superior in all cases.

Table 2

COMPARISON OF WASTEWATER SLUDGE DISPOSAL METHODS

LANDFILL OF DEWATERED SLUDGE	INCINERATION AND LANDFILL	LAND APPLICATION OF SLUDGE
Sewage sludge will contain most of the pathogenic organisms, viruses, heavy metals and synthetic organic materials contained in the raw wastewater (high pH should destroy pathogens in lime sludges).	Complete incineration of wastewater sludge is the most effective means of total sludge disinfection.	The potential for contamination of domestic and wild animals by pathogenic organisms is greater than for the other alternatives.
Leachate from a landfill (if uncontrolled) may be high in nitrates and heavy metals and could contaminate groundwater.	Waste solids (ash) from incineration would consist of inert materials including most heavy metals and phosphorus in the unincinerated sludge.	Land could become saturated with heavy metals, pesticides and organic chemicals if used over prolonged periods.
If not properly covered, a sewage sludge landfill could be a source of contamination of domestic and wild animals.	The small quantity of material (heavy metals, SO_x, NO_x, CO) which would escape the air pollution control equipment could have adverse effects on the environment.	Potential contamination of ground waters with nitrates and heavy metals if aerobic conditions were not maintained.
Wastewater solids would be confined to the immediate area of the fill for future recovery and reuse if practicable.	Most phosphorus and heavy metals originally in the wastewater would be confined to the landfill area allowing reclaimation at a future date if practical.	Runoff, if not controlled, could cause both health and water quality problems.
Sludge landfill areas would have restricted usefullness upon completion of fill activities. Best application would be as green space or recreational areas.	Incineration of sewage sludge would require a supplementary fuel source of up to 6 million BTU per dry ton of sludge. (6 million BTU of fuel could produce 600 kwhr of electric power).	Sludge can be applied continuously at a rate of 10 tons/acre/year or by burying sludge in trenches several hundred tons can be applied per acre although the average of 10-25 tons/acre/year should not be exceeded.
Gas (methane) production may be a problem for a few years after completion of fill activities.	Ash could be landfilled at 15,000 - 20,000 tons per acre (an equivalent 30 - 50 thousand dry tons of sludge/acre).	Land used for disposal of sludge could be farmed; although concentration of heavy metals in plants would have to be monitored.
Sludge dewatered on vacuum filters could be landfilled at a rate of 4000 - 8000 tons (dry) per acre.	Land utilized for landfilling ash would be useable immediately following fill and could structurally support single level construction.	
	Ash has reuse potential as fine aggregate for concrete block manufacturing, as a soil conditioner (if rich in lime), and as a fill stabilizer.	

Stormwater Management

Storm runoff has recently been identified as a major source of urban water pollution. The runoff may either come from separate storm sewers or as overflow from sewers designed to carry both urban wastewater and storm runoff. The overflow from combined sewers is the most serious of the storm runoff problems since a portion of the untreated sanitary wastewater has mixed with the storm runoff. The problem is most serious in the Clinton and Rouge Rivers in Southeastern Michigan.

The stormwater system being considered by the State of Michigan would address only stormwater entering a combined sewer system. Storm flows would be stored utilizing capacities of existing sewers and several regional subsurface storage facilities. That flow which exceeds the capacity of the storage system would receive a minimum treatment of screening, sedimentation, skimming and chlorination. That stormwater which is stored would be released to the regional interceptor system at a controlled rate and receive treatment in the municipal wastewater facility. The goal of the system is to treat combined stormwater to at least the same quality as separate stormwater. The percentage of the combined stormwater to receive full treatment would be a function of the total storage volume provided.

Treatment of storm runoff presents some difficult design problems. Storm flows are intermittent and the rate of flow far exceeds the normal flow to a wastewater treatment facility. Thus, in order to treat stormwater, a system of temporary storage which would allow controlled release to the treatment facility would be necessary.

Some possibilities for storage are: use of excess volume within existing sewers, multiple surface or subsurface storage facilities, regional surface storage, and regional deep mined storage. A regional system with central treatment may also require a large network of interceptor sewers if existing systems are insufficient.

The system designed for collection storage and transmission of stormwater for this study is shown in figure 1. There are basically two systems of collection and storage utilized. In the suburban areas, a system of interceptors and force mains would bring storm runoff to a surface or subsurface storage facility. These storage facilities range in size from 80 to 690 acres. The collected stormwater would then be released to a connecting interceptor system for conveyance to treatment. In the more highly urbanized areas where construction of surface reservoirs would not be practical, large diameter rock tunnels were designed which would convey storm runoff at peak flows to regional surface reservoirs (3210 acres each) located north and south of Detroit.

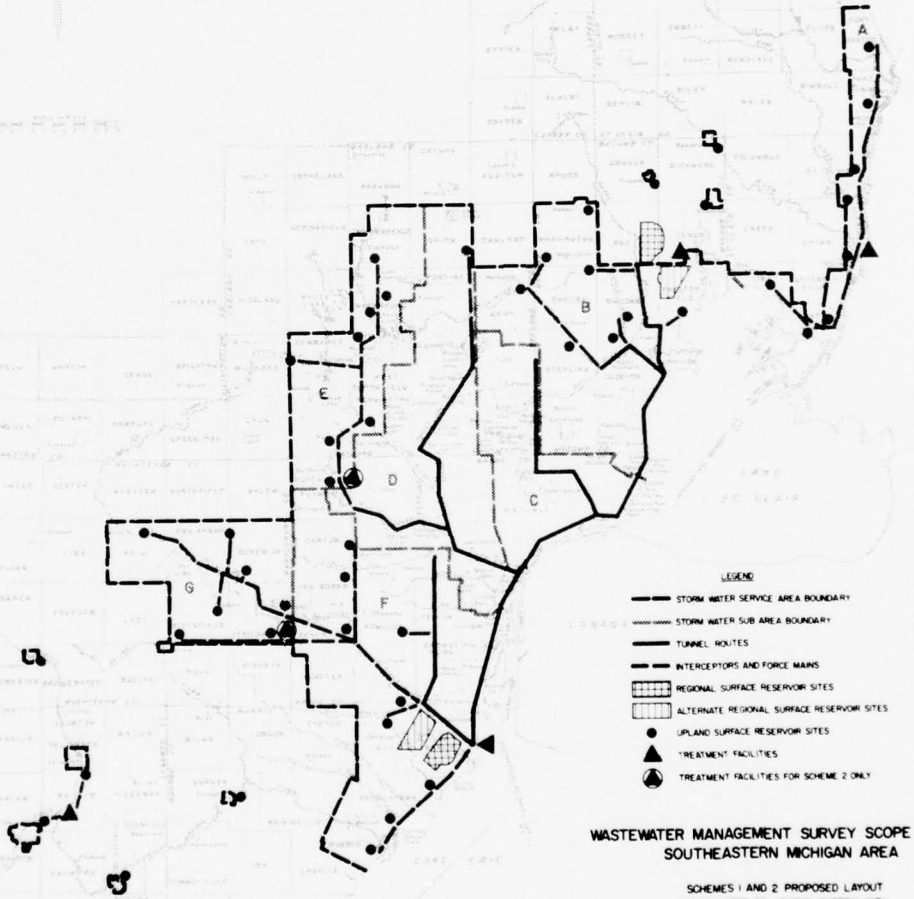
The large high lift pumps required at the regional reservoirs would require as much as 1850 megawatts of power for relatively short periods of time and on relatively short notice. This would require standby diesel or gas turbine power generation equipment since normal thermal power generation equipment would not be able to meet that type of demand. 1850 megawatts of standby generating capacity would be a significant asset to a metropolitan area such as Detroit.

There are other advantages which could be realized by implementation of a storm runoff collection and treatment system. Table 3 points out some of the advantages and disadvantages which could be realized by system implementation.

TABLE 3

EVALUATION OF STORM RUNOFF MANAGEMENT

ADVANTAGES	DISADVANTAGES
Water quality would be improved in rivers and streams since the oils, BOD, and suspended solids characteristic of storm runoff would be significantly reduced.	Large quantities of land would be required close to urbanized areas for construction of storage facilities.
Risks to public health due to waterborn transmission of disease pathogens would be reduced.	There would be a potential odor problem in the vicinity of storage facilities which would receive primarily combined sewer overflow.
Stormwater storage would be somewhat effective in reducing peak flows in rivers and streams. The degree of peak flow reduction would be a function of the amount of storage provided and the percentage of the basin served by the system.	Costs for transmission, storage and treatment would be high since a new collection system would be required to carry stormwater from present discharge points to the treatment or storage facility. Storage facilities would also be large and costly.
A good storm runoff control system in conjunction with an effective wastewater treatment system would allow expanded development of water based recreation.	Power required for pumping of peak storm flows would require special generating facilities. Power requirements for construction of deep rock tunnels would also be large.
Areas surrounding storage facilities would lend themselves well to green belt or recreational development.	Disposal areas for stormwater sludge would have to be found.
Power generating facilities capable of meeting the peak flow power demands of the system would be a valuable source of emergency power for the region.	Residents and commercial and industrial establishments located at sites designated for stormwater facilities would have to relocate.
Expanded treatment facilities for treatment of stormwater whether at a separate location or a part of the wastewater facility could be useful as a back-up to the wastewater treatment system.	



WASTEWATER MANAGEMENT SURVEY SCOPE STUDY
SOUTHEASTERN MICHIGAN AREA

SCHEMES 1 AND 2 PROPOSED LAYOUT
STORM WATER COLLECTION SYSTEM WITH
SURFACE STORAGE

FIGURE 1

Chapter VI

PRELIMINARY ALTERNATIVES

Introduction

As stated in the Summary Report, "The aim of this study was to provide local, county, regional, state and federal officials with long-range wastewater management plans for southeastern Michigan which would complement the water quality plans of the State of Michigan and thus assist in meeting the planning requirements of Public Law 92-500." Wastewater planning in the state and region has been primarily directed toward meeting what has become the interim goals of Public Law 92-500. The Corps used that planning as a basis for developing wastewater management alternatives capable of approaching if not attaining the ultimate goal of P.L. 92-500, "that the discharge of pollutants into navigable waters be eliminated by 1985."

An alternative plan was developed from the State of Michigan water quality plan. The plan is referred to as the Interim Water Quality Plan since it is felt that the plan could at best meet only the 1983 requirement of "best practicable technology" in Public Law 92-500. The plan was not developed, however, as an interim plan to any of the plans designed to achieve the 1985 goals of the law since implementation of the Interim Water Quality Plan would technically preclude the achievement of the "no discharge of pollutants" goal by 1985.

The alternative plans designed to meet the "no discharge of critical pollutants" goal were developed using the three advanced treatment technologies discussed in the preceding section. Wastewaters collected and renovated include municipal and industrial wastewater, overflow from combined sewers and urban storm runoff. Minimum effluent quality expected from any of the treatment facilities would be:

BOD_5	4 mg/l
COD	10 mg/l
Suspended Solids	2 mg/l
Total Phosphorus	0.1 mg/l
Ammonia Nitrogen	0.3 mg/l
Total Nitrogen	3.0 mg/l

In addition, most heavy metals, synthetic organic chemical and pesticides would be reduced to trace levels. All treatment facilities would also yield an effluent relatively free of pathogens.

All of the plans use essentially the same collection system to convey wastewater to certain key points such as the Detroit plant site, the Wyandotte plant site and a point near the mouth of the Huron River. These systems are common since most of the required interceptors are in existence or have reached an advanced stage in planning. The stormwater collection, storage and transmission system is also common to each alternative plan.

Initially plans were developed utilizing each of the advanced treatment methods (AWT, IPCT and Land) as the primary method of wastewater treatment. In all cases stormwater treatment was limited to independent physical-chemical and land irrigation treatment processes since it is difficult to maintain efficient biological treatment with the wide variations of flow rate and wastewater strength characteristic of storm flows. Additional single treatment plans were designed utilizing alternative sludge handling processes so that the impacts associated with regional use of each method could be evaluated. The remainder of the preliminary

alternatives were developed to examine logical combinations of the wastewater treatment technologies.

In the remainder of this section, the preliminary alternative plans are presented along with an impact identification table for each plan. The tables list major impacts and potential impacts identified by the evaluators and indicate the primary and secondary areas of impact. The comments in the table are for the most part general and not quantitative since most of the facility locations were area rather than site specific and in many cases specific data was not available to the evaluator.

Interim Water Quality Plan

The Interim Water Quality Plan has been developed from the plan developed by the State of Michigan Department of Natural Resources in cooperation with the planning agencies in the area. Depending upon the interpretation of Public Law 92-500, this plan could satisfy the interim goal stated in the Law. The plan should be capable of achieving ". . . wherever attainable . . . a water quality which provides for the protection and propagation of fish, shellfish, and wildlife and provides for recreation in and on the water" by July 1, 1983. If this plan were implemented to satisfy the 1983 goals, however, there would be little potential for approaching the ultimate goal of Public Law 92-500; to eliminate "the discharge of pollutants into the navigable water" by 1985.

In this plan (see figure 2) 46 wastewater treatment plants in the area would provide treatment of municipal and industrial wastewater, and overflow from the combined sewers. Three regional plants located in Detroit, Wyandotte and at the Huron River would have a total design-treatment capacity of 1420 million gallons per day (MGD). Forty-three minor plants having a total design capacity of 160 MGD would serve communities not a part of the regional system. Plant locations can be seen on the

figure. Many of the minor plants are considered interim facilities to provide treatment until growth of the community would justify further extension of the regional interceptor system.

The degree of treatment required at a particular plant would depend upon the water body into which the plant discharges. Plants which would discharge directly to the St. Clair River, the Detroit River, or Lake Erie would be required to provide an equivalent of secondary treatment and remove a minimum of 80 percent of the phosphorus. Plants discharging to inland streams would be required to provide a higher degree of treatment as shown below:

EFFLUENT REQUIREMENTS
FOR PLANTS DISCHARGING TO INLAND STREAMS

5 - Day BOD	4.0 mg/l
Ammonia Nitrogen	0.5 mg/l
20 - Day BOD	8.0 mg/l
DO in the effluent	5.0 mg/l minimum
Total Phosphorus Removal	80% minimum
Suspended Solids	15.0 mg/l
Fecal Coliform	100/100 ml
Total Coliform	1000/100 ml

Additional interceptors would be required to provide transportation of wastewater being generated from the newly developed portions of the

FIGURE 2

INTERIM WATER QUALITY PLAN

MUNICIPAL, INDUSTRIAL & COMBINED SEWER OVERFLOW WASTEWATER

1990 service area. The Detroit collection system would be expanded to serve developing portions of Macomb and Oakland Counties. Additional interceptors would also be built to relieve overloaded portions of the existing combined sewer system most prevalent in older portions of the service area. The collection system which terminates at the Wyandotte plant would remain unchanged since it is not expected to expand and the area it serves is already developed to a large degree. The collection system which would lead to the proposed Huron River Plant would have to be constructed in its entirety. This sewerage system would serve a major portion of the new development in southeastern Michigan.

Sewage sludges in all but two of the plants would be incinerated and ash disposed of in a landfill. The relatively limited availability of landfills near the large urban plants makes this method feasible.

The two plants which would not have incinerators, Algonac and Adrian, would dewater the sludge and landfill it. These plants are fortunate to be in locations where landfill sites are available and are within economic haul distance from the plant. The quantity of sludge produced at these two plants would also be small enough that the quantities are not a limiting factor.

The combined sewered systems of southeastern Michigan contribute a significant pollutant load to the surface waters of the area through bypasses and overflows. To meet the water quality goals of the region, three plans were developed for controlling the combined sewer overflows and thus limiting the total pollutants discharged to a receiving stream. In each plan, a specified volume of combined sewer overflows would be stored in numerous facilities constructed throughout the area. These facilities would provide for the retention of floating debris by skimming, chlorination for effective disinfection of the overflows which would occur when the storage capacity is exceeded, and the removal of septic solids buildup deposited by smaller retained storms over an extended period.

TABLE 18

INTERIM WATER QUALITY PLAN
IMPACT IDENTIFICATION TABLE

	THE IMMEDIATE VICINITY OF A WASTEWATER FACILITY	THE AREA IN SOUTHEASTERN MICHIGAN SERVED BY THE WASTEWATER SYSTEM	DIRECTLY AFFECTED AREAS OUTSIDE THE SERVICE AREA
I. WATER QUALITY			
A. SURFACE WATERS		Significant improvement could be expected in the water quality in the St. Clair, Clinton, Rouge, Huron, Detroit, Raisin and other inland rivers; *however, lower water quality following* storms would continue due to uncontrolled discharge of separate sewered urban storm runoff.	
		Peak storm flows would be equalized somewhat in the Rouge and Clinton Rivers due to the combined sewer overflow storage system.	
		Unless supplementary water supply was developed for the Ann Arbor-Ypsilanti area, abnormally low flows could occur in the lower Huron River.	
B. GROUND WATER	Ground water contamination could result from poorly managed disposal of stormwater solids and unincinerated sewage sludges.		
II. AQUATIC LIFE AND WATERFOWL		Habitats for intolerant game fish would be significantly improved in southeastern Michigan rivers and streams; however, artificial stocking would be required to *maintain populations.*	
III. PUBLIC HEALTH		*Pathogen contamination from treatment plant* effluents and combined sewer overflow would be reduced significantly; however, complete disinfection would not be achieved.	
		Infectious disease could be spread by waterfowl or other animals allowed access to surface stormwater storage lagoons.	
	A potential hazard would exist where large quantities of chlorine would be handled (On site chlorine production would significantly reduce the hazard).		
	Increased concentrations of pathogens could be expected in the air in the vicinity of activated sludge aeration basins.		
IV. ENERGY AND NATURAL RESOURCES A. AIR		Some gaseous (NO_x and SO_x) and particulate matter would be emmitted from sewage sludge incinerators.	
	A plume would be visible at incineration sites due to condensed water vapor.		
B. CHEMICALS		14,000 tons of chlorine (or raw materials, salt and *electrical energy*: 2600 kwhr/ton Cl_2) would be consumed annually.	
		Chemicals required for phosphorus removal would include lime, waste pickle liquor, iron salts, alum or other commercial chemicals. Quantities would be *significant* but have not been determined.	
C. ELECTRICAL POWER		132 megawatts of electrical power would be required to operate wastewater treatment plants. *Additional electrical power would be required* to operate the stormwater storage system.	
D. FUEL OIL OR NATURAL GAS		*10 billion BTU of heat energy from fuel oil or* natural gas would be required daily for sludge *incineration.*	

The comments in this table are intended to identify impacts only; each comment appears under the column identifying the area of greatest significance. The relative significance for other areas is identified by the screening indicated in the index to the right.

Equally Significant

Partially Significant

Somewhat Significant

Insignificant

THE REST OF THE STATE OF MICHIGAN	THE LAKE ERIE BASIN	THE NATION	CANADA - INTERNATIONAL
This plan would satisfy the water quality goals of the State of Michigan.		This plan could meet the interim (July 1983) water quality goals of P. L. 92-500 but if implemented would preclude achievement of the ultimate goals of the law by 1985.	This plan would meet the intent of the April 1972 agreement with Canada on Great Lakes water quality.
	Employment of this degree of wastewater treatment *throughout the Lake Erie basin would probably* not be effective in achieving nutrient concentrations which would reduce algae problems in the lake.		
	Although lake water quality would be improved through implementation of this plan, the effects would not be obvious to the observer.		
	Any improvement in water quality in Lake Erie would not have an effect on fisheries in the lake unless proper management was practiced in the *commercial fishing industry*.		
	Improved wastewater management would be beneficial to waterfowl since habitats would be improved and concentrations of toxic substances and oils would be reduced.		

TABLE 4

INTERIM WATER QUALITY PLAN
IMPACT IDENTIFICATION TABLE
(CONTINUED)

	THE IMMEDIATE VICINITY OF A WASTEWATER FACILITY	THE AREA IN SOUTHEASTERN MICHIGAN SERVED BY THE WASTEWATER SYSTEM	DIRECTLY AFFECTED AREAS OUTSIDE THE SERVICE AREA
V. EMPLOYMENT		Labor demands for construction would cover a period of 10-12 years. Depending upon the design of the stormwater storage system, labor demands could exceed local supply.	
		Unemployment in the construction trades would be expected to drop with the advent of construction and increase upon completion of the project.	
		Operating manpower requirements for the wastewater plants would be 1500. Additional manpower would be required to staff the stormwater storage system.	
VI. LAND AND WATER USE CHANGES	Land use would have to be changed for the plant at the Huron River, for plant expansion at Wyandotte and Detroit, and for construction of the stormwater storage system.		
		The areas surrounding new treatment and storage facilities have a potential use by local units of government as open space and recreational areas.	
		Improved water quality in Lake St. Clair and inland rivers would allow increased development of water based recreation.	
VII. LAND VALUES	Some loss of property value may be experienced in the vicinity of wastewater management facilities due to the stigma associated with such facilities.		
		Land values along southeastern Michigan shorelines should increase due to improved water quality over the area and peak flow reduction in the Rouge and Clinton Rivers.	
VIII. AREA ECONOMY AND INSTITUTIONS		The history of growing intergovernmental cooperation in southeastern Michigan lays the basis for a regional approach to wastewater management.	
		781 acres of land for wastewater treatment plants and additional land for stormwater storage facilities would be removed from the tax base of local and county governments.	
		The regional economy would be stimulated temporarily due to demands for construction materials and increased construction payrolls.	
		There would be an area-wide decrease in disposable income of each family due to increased sewer charges to offset costs shown in X. below.	
		Implementation of the plan would be contrary to the goals of some communities, particularly Ann Arbor, which desire to maintain autonomy.	
		The creation of an unpolluted water supply would not have a significant effect on existing enterprizes, nor is it apt to attract new types of economic activity.	
IX. SOCIO-ECONOMICS	Owners of economic establishments and residents of lands required for construction of wastewater facilities would have to be relocated.		
	Residents of lands near proposed facilities would have their normal lifestyle disrupted and commercial enterprizes near-by would be affected while construction operations where underway.		
		The system would help satisfy a regional need for expanded water based recreation by providing more waters suitable for total body contact recreation.	
X. SYSTEM COSTS			
A. CAPITAL COSTS		$ 547,000,000	
B. AMORTIZED CAPITAL COST (Average annual)		32,000,000	
C. OPERATION AND MAINTENANCE (Average annual)		24,000,000	
D. TOTAL AVERAGE ANNUAL COST		56,000,000	

THE REST OF THE STATE OF MICHIGAN	THE LAKE ERIE BASIN	THE NATION	CANADA - INTERNATIONAL
	Improved water quality in Lake Erie through basin wide wastewater management could offer improved potential for development of water based recreation.		
		$ 1,643,000,000 97,000,000 97,000,000	

From storage, the retained stormwater would be reintroduced into the interceptor system at a lower rate and treated at the same facility used to treat the municipal-industrial flow from the area. The most extensive storage system was selected since the other two plans would probably not be sufficient to meet the interim water quality goals. The location, type of storage, and land requirements are not shown on the figure as they have not yet been defined.

Advanced Wastewater Treatment Alternative One

This alternative utilizes advanced wastewater treatment as the primary method of municipal-industrial wastewater treatment. Storm runoff would be treated by the independent physical-chemical treatment process. Sewage sludges would be disposed of by the most cost effective method as identified by the contractor; and lime sludges would be recalcined and reused. The alternative would make maximum use of four existing regional plants in the area while minimizing loss of treatment effectiveness during the implementation period.

The system would utilize seven regional advanced wastewater treatment facilities located as shown in figure 3A. The existing plants located at Port Huron, Detroit, Wyandotte and Monroe would be upgraded and expanded as necessary to meet the requirements of the system. New plants would be constructed at East China, near the mouth of the Huron River, and east of Adrian. Additional community advanced treatment plants would be located as shown in the figure.

Major interceptor construction necessary for implementation of this alternative would include: an interceptor along the shoreline in southern St. Clair County, an interceptor along the Detroit River to the Huron River, an interceptor from Ann Arbor following the Huron River to its mouth, and an interceptor following Hannan Road north of the Huron River.

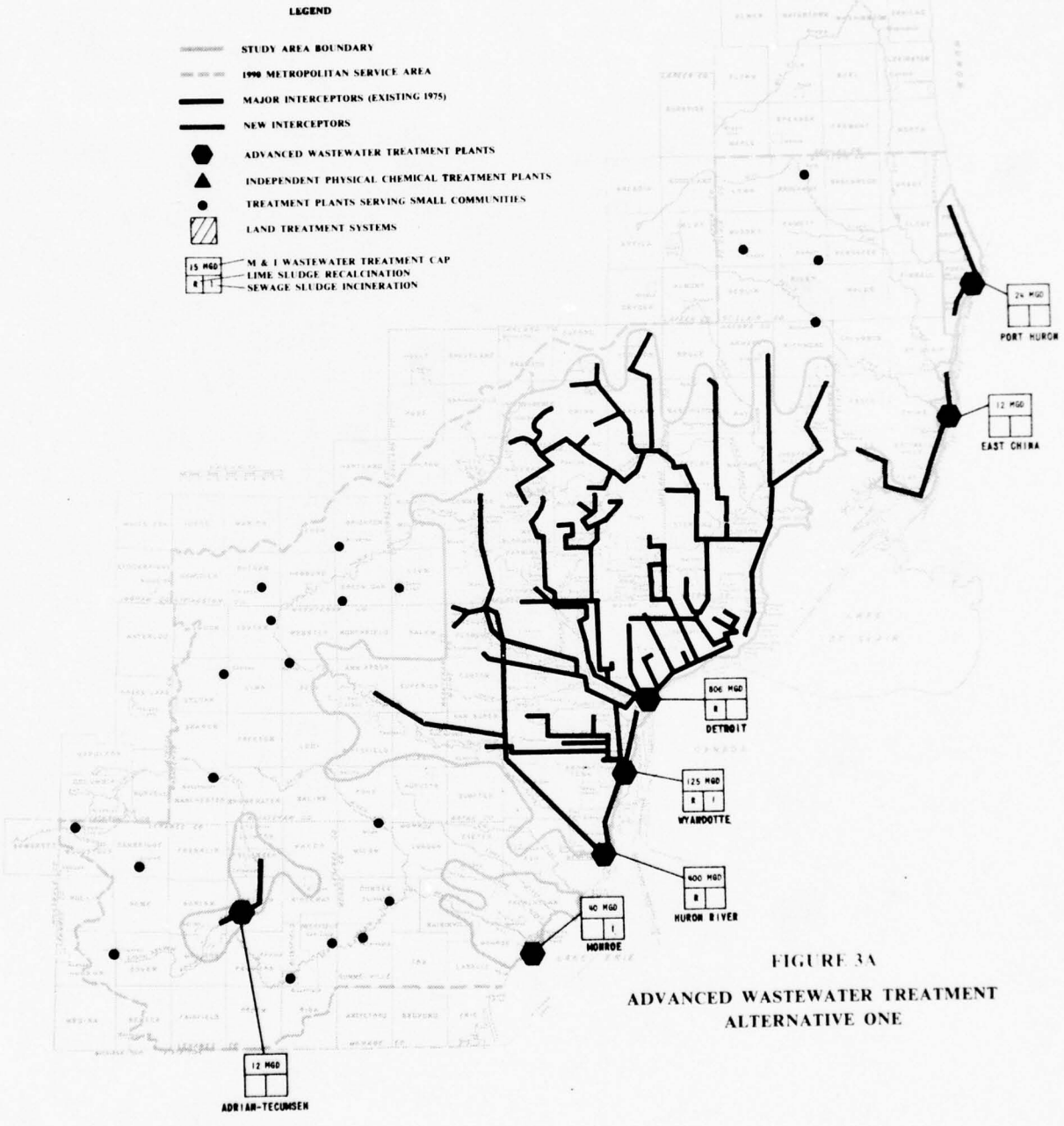


FIGURE 3A

ADVANCED WASTEWATER TREATMENT
ALTERNATIVE ONE

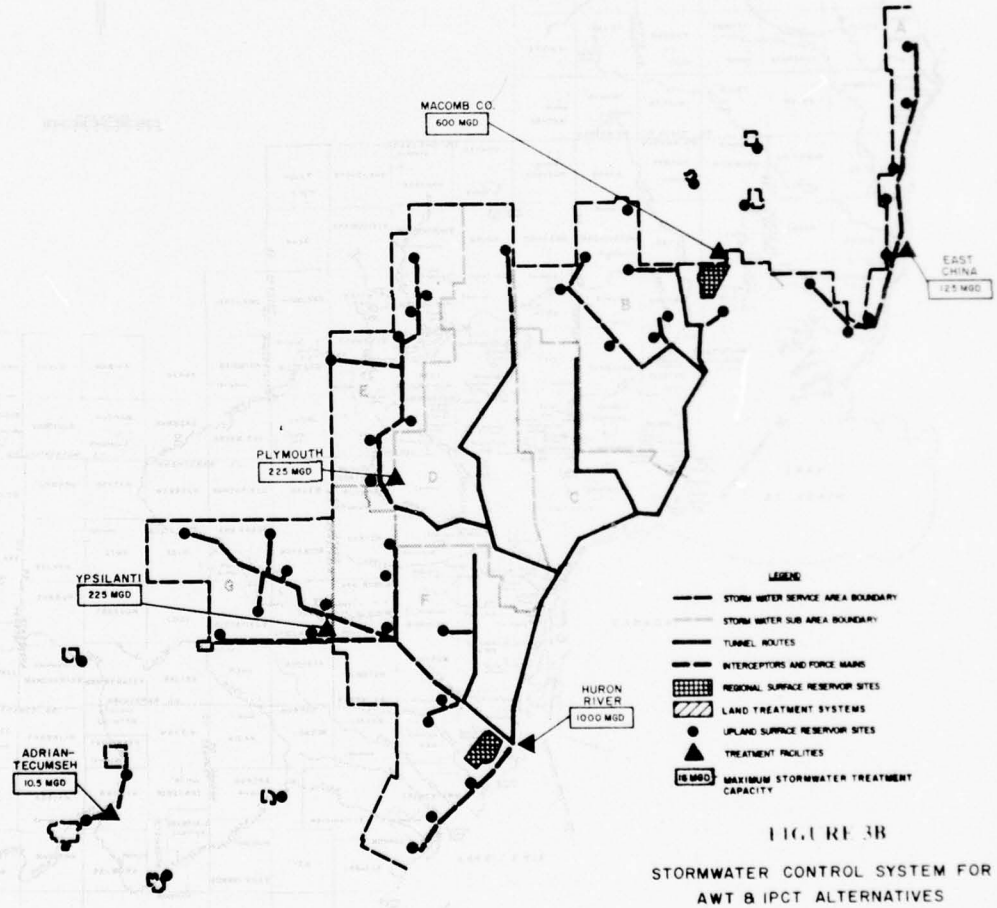


FIGURE 3B

STORMWATER CONTROL SYSTEM FOR AWT & IPCT ALTERNATIVES

The system designed for handling combined sewer overflow and urban storm runoff would be essentially independent of the municipal-industrial wastewater treatment system. (See figure 3B). The stormwater system would utilize forty-nine community storage reservoirs ranging in size from 80 to 690 acres. These and two regional reservoirs of 3,120 acres each would be used for temporary storage of peak storm flows. Treatment of collected stormwater would be carried out at six facilities. Two of the facilities utilizing the IPCT process would be at the location of regional storage reservoirs in Monroe (collocated with Huron River M & I plant) and Macomb Counties (Chesterfield Township). Two additional IPCT plants would be located on the Rouge River at Plymouth and on the Huron River south of Belleville Lake. Stormwater would also be treated at the site of the East China plant and at the Adrian-Tecumseh site.

An extensive system of interceptors and tunnels would be required to collect storm runoff and combined sewer overflows at the present points of discharge to surface waters. Normal sewer construction techniques would be utilized in less urbanized areas; however, the greater size of sewers required in highly urbanized areas and the construction problems encountered made design of hard rock tunnels necessary.

Sludges generated by the system would be handled by several methods. Primary and secondary sewage sludges would be incinerated at plants in Monroe and Wyandotte, the ash being disposed of by landfill. The remainder of the sewage sludges would be dewatered and hauled to landfill sites in St. Clair and Lenawee Counties. Lime sludges generated at all treatment plants with the exception of Port Huron and Monroe would be recalcined for lime recovery. Sludges not recalcined would be disposed of in landfill areas. A major additional source of waste solids would be the solid material which would accumulate in stormwater storage facilities. That material would be disposed of by landfill.

Costs, energy and chemical demands for the system are covered in the

TABLE 5

ADVANCED WASTEWATER TREATMENT ALTERNATIVE ONE IMPACT IDENTIFICATION TABLE

	THE IMMEDIATE VICINITY OF A WASTEWATER FACILITY	THE AREA IN SOUTHEASTERN MICHIGAN SERVED BY THE WASTEWATER SYSTEM	DIRECTLY AFFECTED AREAS OUTSIDE THE SERVICE AREA
I. WATER QUALITY			
A. SURFACE WATERS		Significant improvements could be expected in the water quality in the St. Clair, Clinton, Rouge, Huron, Detroit and Raisin Rivers due to elimination of urban stormwater and wastewater discharges.	
		Peak storm flows would be equalized in the Rouge, Huron and Clinton Rivers due to stormwater storage facilities.	
B. GROUND WATER	Ground water contamination could result if sludge landfills in St. Clair and Lenawee Counties were not properly operated (primary contaminants: nitrates & heavy metals).		
II. AQUATIC LIFE AND WATERFOWL		Habitats for intolerant game fish would be improved; however, artificial stocking would be required to maintain populations.	
III. PUBLIC HEALTH		Pathogen contamination from treatment plant effluents and uncontrolled discharge of urban storm runoff and combined sewer overflow would be virtually eliminated.	
		Infectious disease could be spread by waterfowl or other animals allowed access to stormwater storage lagoons or uncovered sludge landfill areas.	
	A potential hazard would exist where large quantities of chlorine would be handled (On site chlorine production would significantly reduce the hazards).		
	Increased concentrations of pathogens could be expected in the air in the vicinity of advanced wastewater treatment plant aeration basins.		
IV. ENERGY AND NATURAL RESOURCES			
A. AIR		Some gaseous (NO_X and SO_X) and particulate matter would be emmitted from incineration, lime sludge recalcination and carbon regeneration facilities at treatment plant sites.	
	A plume would be visible at incineration and lime sludge recalcination sites due to condensed water vapor.		
B. CHEMICALS		73,000 tons of chlorine (or raw materials, salt and electrical energy: 2600 kwhr/ton Cl_2) would be consumed annually.	
		575,000 tons of lime (or raw materials, limestone rock and heat energy: 4.25-8.25 million BTU/ton lime) would be consumed annually.	
		75,000 tons of methanol (brewery waste could be substituted) would be consumed annually.	
C. ELECTRICAL POWER		The average electrical power demand of 315 megawatts is within the planned capabilities of Detroit Edison.	

The comments in this table are intended to identify impacts only; each comment appears under the column identifying the area of greatest significance. The relative significance for other areas is identified by the screening indicated in the index to the right.

Equally Significant | Somewhat Significant | Partially Significant | Insignificant

THE REST OF THE STATE OF MICHIGAN	THE LAKE ERIE BASIN	THE NATION	CANADA - INTERNATIONAL
This plan would result in water of higher quality than presently required by the State of Michigan.		This plan meets the intent and time-phased goals of Public Law 92-500.	This plan would comply with the April 1972 agreement with Canada on Great Lakes water quality.
	There is little potential for significant improvement in the western half of Lake Erie with respect to algal blooms and oxygen depletion.		
	If similar wastewater management projects were carried out in the remainder of the Lake Erie basin, ecological recovery may be possible in the eastern half of the lake.		
	Although the habitat for intolerant fishes would be improved in Lake Erie, improvement of fisheries will depend on management practices in the *commercial fishing industry*.		
	Waterfowl populations may improve due to improved habitats and food supplies.		

TABLE 5 (CONTINUED)
ADVANCED WASTEWATER TREATMENT ALTERNATIVE ONE
IMPACT IDENTIFICATION TABLE

	THE IMMEDIATE VICINITY OF A WASTEWATER FACILITY	THE AREA IN SOUTHEASTERN MICHIGAN SERVED BY THE WASTEWATER SYSTEM	DIRECTLY AFFECTED AREAS OUTSIDE THE SERVICE AREA
		The additional 1850 megawatts required for peak stormwater pumping would be met by stand-by generators which could also serve as emergency back-up to the regional power grid.	
D. FUEL OIL OR NATURAL GAS		24 billion BTU of heat energy from fuel oil or natural gas would be required daily.	
V. EMPLOYMENT		Labor demands for construction would cover a period of 10-12 years. The demands for that period would exceed the local supply thus requiring labor from outside the region.	
		Unemployment in the construction trades would be expected to drop with the advent of construction and increase upon completion of the project.	
		The total operating manpower required would be 3728. Special training programs would be necessary to meet demands for *technicians and specialty labor* categories.	
VI. LAND AND WATER USE CHANGES	Essentially all of the proposed facilities would somewhat alter existing and proposed land use. Expansion of the Port Huron plant would be difficult due to its location in a modern commercial district.		
		Buffer areas specified for most wastewater facilities have potential use by local units of government for open space or recreational areas.	
		Implementation of this plan would necessitate development of a supplementary water source for the Ann Arbor-Ypsilanti area to avoid abnormally low flows in the Huron River.	
	A potential would exist for developing local industrial water supplies utilizing renovated wastewater particularly in the vicinity of facilities near Adrian, Ypsilanti, Plymouth and the Huron River. Industrial expansion could thus be encouraged in areas previously not industrially oriented.		
VII. LAND VALUES		Land values along southeastern Michigan shorelines should increase due to improved water quality over the area and peak flow reduction in the Rouge and Clinton Rivers.	
	Some loss of property value may be experienced in the vicinity of wastewater management facilities due to the stigma associated with such facilities.		
VIII. AREA ECONOMY AND INSTITUTIONS		*The history of growing intergovernmental* cooperation in southeastern Michigan lays the basis for a regional approach to wastewater management.	
		Implementation and operation of this alternative would require one or several management organizations having a number of comprehensive management capabilities (i.e. planning, financing, construction, operation, maintenance and administrative capabilities).	
		Implementation of this plan would be contrary to the goals of some communities, particularly Ann Arbor, Pontiac and Warren, which desire to maintain autonomy.	
		31,400 acres of land would be removed from the tax base of local and county governments.	
		All existing treatment facilities in the service area with the exception of Detroit, Wyandotte, Port Huron and Monroe would be phased out by 1985.	
		The regional economy would be stimulated temporarily due to demands for construction materials and increased construction payrolls.	

The comments in this table are intended to identify impacts only; each comment appears under the column identifying the area of greatest significance. The relative significance for other areas is identified by the screening indicated in the index to the right.

Equally Significant

Somewhat Significant

Partially Significant

Insignificant

THE REST OF THE STATE OF MICHIGAN	THE LAKE ERIE BASIN	THE NATION	CANADA - INTERNATIONAL

TABLE 5 (CONTINUED)
ADVANCED WASTEWATER TREATMENT ALTERNATIVE ONE
IMPACT IDENTIFICATION TABLE

	THE IMMEDIATE VICINITY OF A WASTEWATER FACILITY	THE AREA IN SOUTHEASTERN MICHIGAN SERVED BY THE WASTEWATER SYSTEM	DIRECTLY AFFECTED AREAS OUTSIDE THE SERVICE AREA
		Gross income in the area would increase due to increased wastewater system payrolls; however, there would be an area-wide decrease in disposable income of each family due to increased sewer charges to offset costs shown under X. below.	
		The creation of an unpolluted water supply would not have a significant effect on existing economic enterprizes, nor is it apt to attract new types of economic activity.	
IX. SOCIO-ECONOMICS	*Owners of economic establishments and residents of lands required for construction of wastewater facilities would have to be relocated.*		
	Residents of lands near proposed facilities would have their normal lifestyle disrupted and commercial enterprizes near-by would be affected while construction operations were underway.		
		The system would help satisfy a regional need for expanded *water based recreation by providing more* waters suitable for total body contact recreation.	
X. SYSTEM COSTS			
A. CAPITAL COSTS		$1,059,000,000	
B. AMORTIZED CAPITAL COST (Average annual)		62,000,000	
C. OPERATION AND MAINTENANCE (Average annual)		120,000,000	
D. TOTAL AVERAGE ANNUAL COST		182,000,000	

The comments in this table are intended to identify impacts only; each comment appears under the column identifying the area of greatest significance. The relative significance for other areas is identified by the screening indicated in the index to the right.

Equally Significant 

Somewhat Significant 

Partially Significant 

Insignificant 

THE REST OF THE STATE OF MICHIGAN	THE LAKE ERIE BASIN	THE NATION	CANADA - INTERNATIONAL
		$3,178,000,000	
		188,000,000	
		188,000,000	

impact table (Table 5) The additional land required for the system is also an important consideration. Total land needs by type of operation are:

Treatment Plants	1,382 Acres
Stormwater Storage	23,800 Acres
Sludge Landfill (50 years)	6,487 Acres

Advanced Wastewater Treatment Alternative Two

This alternative also utilizes advanced wastewater treatment as the primary method of municipal-industrial wastewater treatment and independent physical-chemical treatment to handle stormwater. In order to limit sludge hauling and land requirements for disposal, sludge incineration and lime recalcination would be employed at all plants. As in AWT Alternative One, maximum use would be made of the four existing regional plants in the area while minimizing loss of treatment effectiveness during the implementation period.

This alternative would employ the same facilities for wastewater treatment and stormwater storage and treatment as AWT Alternative One (figures 3A and 3B). The use of sludge incineration and lime sludge recalcination at each plant rather than direct landfill of sludge makes a significant difference in total air emissions, energy consumption and land use. The new land needs by type of operation are:

Treatment Plants	1,382 Acres
Stormwater Storage	23,500 Acres
Sludge Landfill (50 years)	3,201 Acres

Other requirements for this alternative can be found in Table 6.

Independent Physical-Chemical Treatment Alternative One

This alternative would utilize independent physical-chemical treat-

TABLE 6
ADVANCED WASTEWATER TREATMENT ALTERNATIVE TWO
IMPACT IDENTIFICATION TABLE

A	THE IMMEDIATE VICINITY OF A WASTEWATER FACILITY	THE AREA IN SOUTHEASTERN MICHIGAN SERVED BY THE WASTEWATER SYSTEM	DIRECTLY AFFECTED AREAS OUTSIDE THE SERVICE AREA
I. WATER QUALITY			
A. SURFACE WATERS		Significant improvements could be expected in the water quality in the St. Clair, Clinton, Rouge, Huron, Detroit and Raisin Rivers due to elimination of urban stormwater and wastewater discharges.	
		Peak storm flows would be equalized in the Rouge, Huron and Clinton Rivers due to stormwater storage facilities.	
B. GROUND WATER	Ground water contamination would be minimized since treatment plant sludges would be incinerated prior to disposal.		
II. AQUATIC LIFE AND WATERFOWL		Habitats for intolerant game fish would be improved; however, artificial stocking would be required to maintain populations.	
III. PUBLIC HEALTH		Pathogen contamination from treatment plant effluents and uncontrolled discharge of urban storm runoff and combined sewer overflow would be virtually eliminated.	
		Infectious disease could be spread by waterfowl or other animals allowed access to stormwater storage lagoons.	
	A potential hazard would exist where large quantities of chlorine would be handled (On site chlorine production would significantly reduce the hazards).		
	Increased concentrations of pathogens could be expected in the air in the vicinity of advanced wastewater treatment plant aeration basins.		
IV. ENERGY AND NATURAL RESOURCES A. AIR		Some gaseous (NO_X and SO_2) and particulate matter would be emmitted from incineration, lime sludge recalcination and carbon regeneration facilities at treatment plant sites.	
	A plume would be visible at incineration and lime sludge recalcination sites due to condensed water vapor.		
B. CHEMICALS		73,000 tons of chlorine (or raw materials, salt and electrical energy; 2600 kwhr/ton Cl_2) would be consumed annually.	
		568,00 tons of lime (or raw materials, limestone rock and fuel energy; 4.25-8.25 *million* BTU / ton lime) would be consumed annually.	
		75,000 tons of methanol (brewery waste could be substituted) would be consumed annually.	
C. ELECTRICAL POWER		The average electrical power demand of 315 megawatts is within the planned capabilities of Detroit Edison.	

The comments in this table are intended to identify impacts only; each comment appears under the column identifying the area of greatest significance. The relative significance for other areas is identified by the screening indicated in the index to the right.

Equally Significant | Somewhat Significant | Partially Significant | Insignificant

THE REST OF THE STATE OF MICHIGAN	THE LAKE ERIE BASIN	THE NATION	CANADA – INTERNATIONAL
This plan would result in water of higher quality than presently required by the State of Michigan.		This plan meets the intent and time-phased goals of Public Law 92-500.	This plan would comply with the April, 1972 agreement with Canada on Great Lakes water quality.
	There is little potential for significant improvement in the western half of Lake Erie with respect to algal blooms and oxygen depletion.		
	If similar wastewater management projects were carried out in the remainder of the Lake Erie basin, ecological recovery may be possible in the eastern half of the lake.		
	Although the habitat for intollerant fishes would be improved in Lake Erie, improvement of fisheries will depend on management practices in the commercial fishing industry.		
	Waterfowl populations may improve due to improved habitats and food supplies.		

TABLE 6 (CONTINUED)
ADVANCED WASTEWATER TREATMENT ALTERNATIVE TWO
IMPACT IDENTIFICATION TABLE

	THE IMMEDIATE VICINITY OF A WASTEWATER FACILITY	THE AREA IN SOUTHEASTERN MICHIGAN SERVED BY THE WASTEWATER SYSTEM	DIRECTLY AFFECTED AREAS OUTSIDE THE SERVICE AREA
		The additional 1850 megawatts required for peak stormwater pumping would be met by stand-by generators which could also serve as emergency back-up to the regional power grid.	
D. FUEL OIL OR NATURAL GAS		36 billion BTU of heat energy from fuel oil or natural gas would be required daily.	
V. EMPLOYMENT		Labor demands for construction would cover a period of 10-12 years. The demands for that period would exceed the local supply thus requiring labor from outside the region.	
		Unemployment in the construction trades would be expected to drop with the advent of construction and increase upon completion of the project.	
		The total operating manpower required would be 4177. Special training programs would be necessary to meet demands for technicians and specialty labor categories.	
	Essentially all of the proposed facilities would somewhat alter existing and proposed land use. Expansion of the Port Huron plant would be difficult due to its location in a modern commercial district.		
		Buffer areas specified for most wastewater facilities have potential use by local units of government for open space or recreational areas.	
		Implementation of this plan would necessitate development of a supplementary water source for the Ann Arbor-Ypsilanti area to avoid abnormally low flows in the Huron River.	
VI. LAND AND WATER USE CHANGES	A potential would exist for developing local industrial water supplies utilizing renovated wastewater particularly in the vicinity of facilities near Adrian, Ypsilanti, Plymouth and the Huron River. Industrial expansion could thus be encouraged in areas previously not industrially oriented.		
VII. LAND VALUES		Land values along southeastern Michigan shorelines should increase due to improved water quality over the area and peak flow reduction in the Rouge and Clinton Rivers.	
	Some loss of property value may be experienced in the vicinity of wastewater management facilities due to the stigma associated with such facilities.		
VIII. AREA ECONOMY AND INSTITUTIONS		The history of growing intergovernmental cooperation in southeastern Michigan lays the basis for a regional approach to wastewater management.	
		Implementation and operation of this alternative would require one or several management organizations having a number of comprehensive management capabilities (i.e. planning, financing, construction, operation, maintenance and administrative capabilities).	
		Implementation of this plan would be contrary to the goals of some communities, particularly Ann Arbor, Pontiac and Warren, which desire to maintain autonomy.	
		28,083 acres of land would be removed from the tax base of local and county governments.	
		All existing treatment facilities in the service area with the exception of Detroit, Wyandotte, Port Huron and Monroe would be phased out by 1985.	
		The regional economy would be stimulated temporarily due to demands for construction materials and increased construction payrolls.	

The comments in this table are intended to identify impacts only; each comment appears under the column identifying the area of greatest significance. The relative significance for other areas is identified by the screening indicated in the index to the right.

Equally Significant

Somewhat Significant

Partially Significant

Insignificant

THE REST OF THE STATE OF MICHIGAN	THE LAKE ERIE BASIN	THE NATION	CANADA - INTERNATIONAL

TABLE 6 (CONTINUED)
ADVANCED WASTEWATER TREATMENT ALTERNATIVE TWO
IMPACT IDENTIFICATION TABLE

	THE IMMEDIATE VICINITY OF A WASTEWATER FACILITY	THE AREA IN SOUTHEASTERN MICHIGAN SERVED BY THE WASTEWATER SYSTEM	DIRECTLY AFFECTED AREAS OUTSIDE THE SERVICE AREA
		Gross income in the area would increase due to increased wastewater system payrolls; however, there would be an area-wide decrease in disposable income of each family due to increased sewer charges to offset costs shown under X, below.	
		The creation of an unpolluted water supply would not have a significant effect on existing economic enterprizes, nor is it apt to attract new types of economic activity.	
IX. SOCIO-ECONOMICS		[illegible]	
		The system would help satisfy a regional need for expanded water based recreation by providing more waters suitable for total body contact recreation.	
X. SYSTEM COSTS			
A. CAPITAL COSTS		$1,061,000,000	
B. AMORTIZED CAPITAL COST (Average annual)		63,000,000	
C. OPERATION AND MAINTENANCE (Average annual)		124,000,000	
D. TOTAL AVERAGE ANNUAL COST		187,000,000	

The comments in this table are intended to identify impacts only; each comment appears under the column identifying the area of greatest significance. The relative significance for other areas is identified by the screening indicated in the index to the right.


Equally Significant


Somewhat Significant


Partially Significant


Insignificant

THE REST OF THE STATE OF MICHIGAN	THE LAKE ERIE BASIN	THE NATION	CANADA - INTERNATIONAL
		$3,183,000,000 188,000,000 188,000,000	

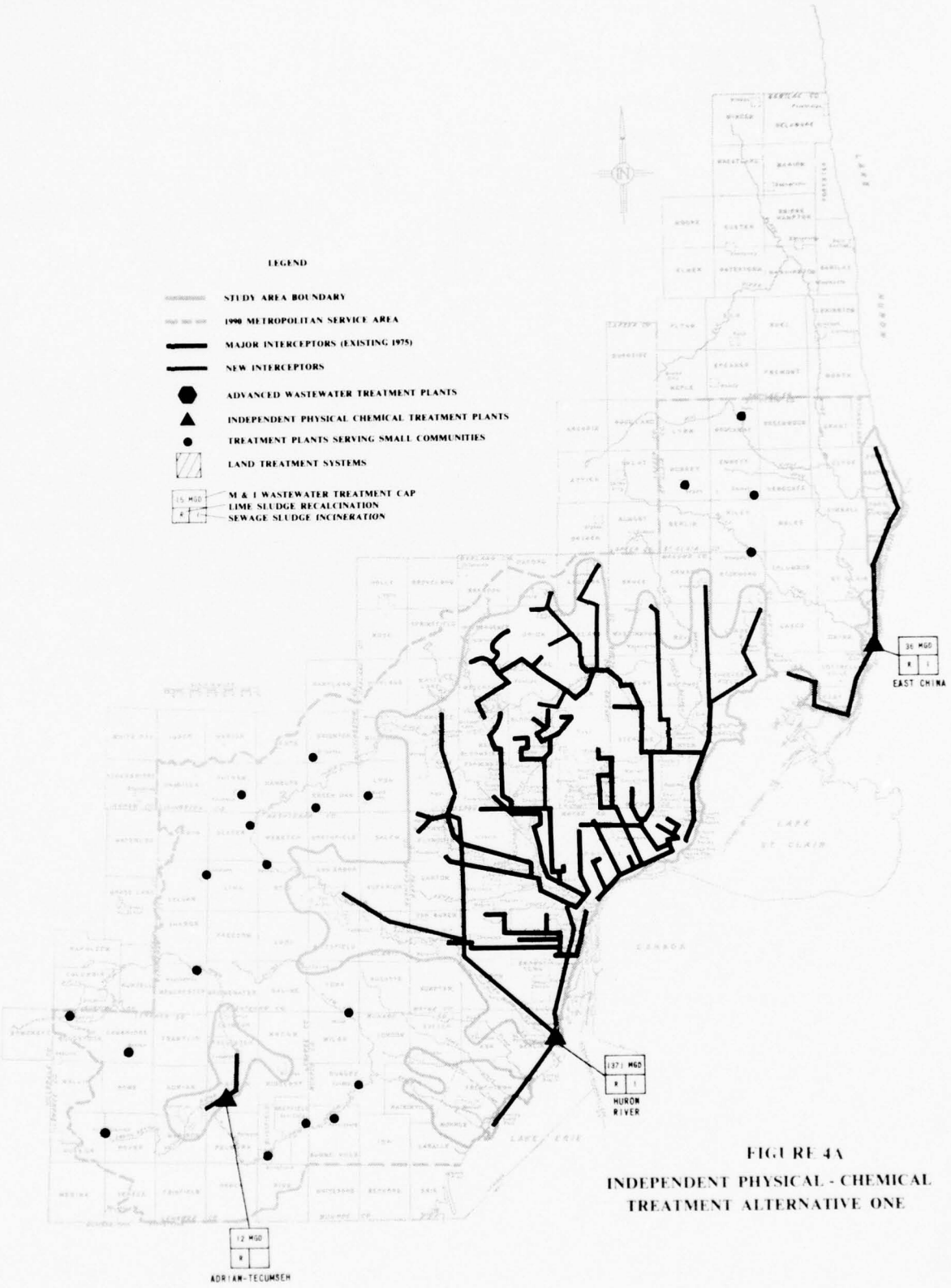


FIGURE 4A

INDEPENDENT PHYSICAL - CHEMICAL TREATMENT ALTERNATIVE ONE

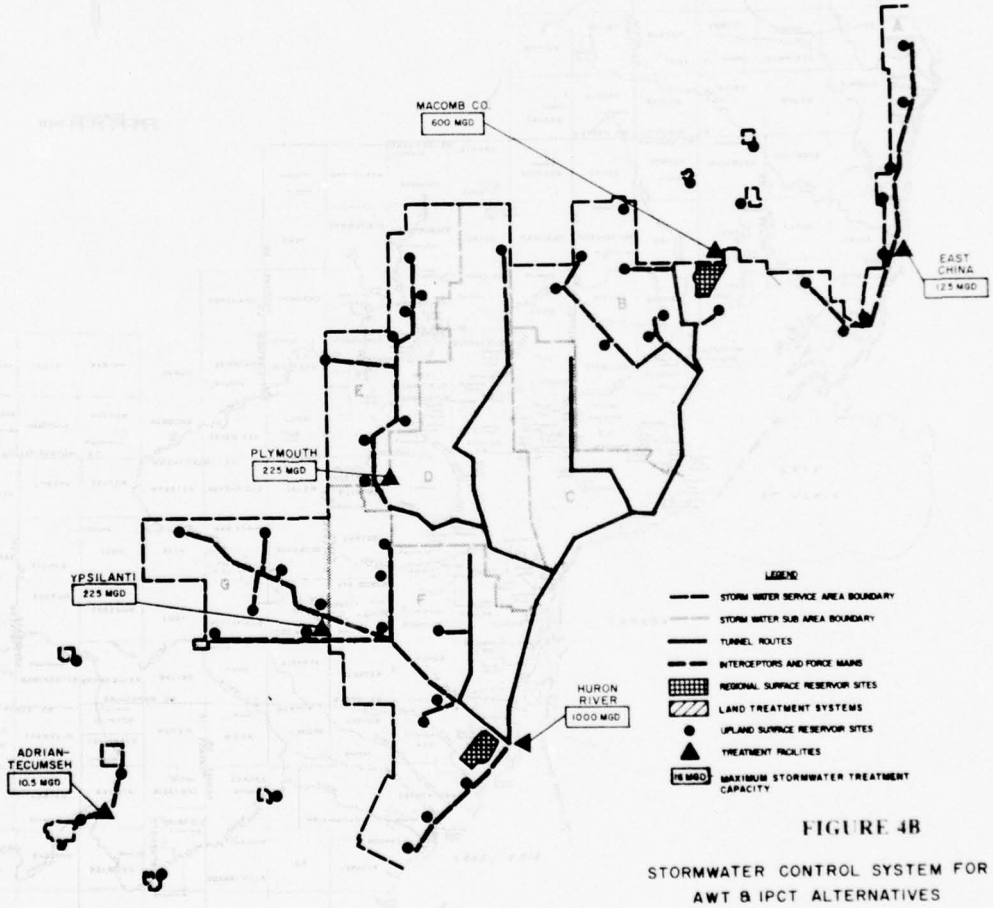


FIGURE 4B

STORMWATER CONTROL SYSTEM FOR AWT & IPCT ALTERNATIVES

ment as the primary method for treatment of both municipal-industrial wastewater and storm runoff. Sludges generated during treatment would be incinerated and recalcined lime would be reused. This plan emphasizes centralized treatment and would abandon all existing regional plants in the area (see figure 4A).

Municipal-industrial wastewater would be treated in only three regional plants, the major plant located near the mouth of the Huron River and two lesser plants located in East China and east of Adrian. Major interceptor construction necessary for implementation of the plan would include: an interceptor along the St. Clair County shoreline, a major interceptor from the present Detroit plant along the Detroit River to the Huron River, an interceptor from Ann Arbor following the Huron River to its mouth, and an interceptor following Hanna Road north of the Huron River. Communities outside the area served by the regional plants would operate small advanced treatment plants until growth would justify extension of regional interceptors.

The system for collection and storage of stormwater would be the same as previously described (see figure 4B). Stormwater treatment facilities would be located at each of the three regional plants. Three additional facilities would be located in Macomb County, Plymouth and south of Ypsilanti.

Wastewater treatment sludges would be incinerated; ash would be landfilled and recalcined lime reused. A major additional source of waste solids would be the solid material which would accumulate in stormwater storage facilities. That material would be disposed of by landfill.

Costs, energy and chemical demands for the system are covered in the impact table (Table 7). The additional land required for the system is also an important consideration. Total land needs by type of operation are:

TABLE 7
INDEPENDENT PHYSICAL-CHEMICAL TREATMENT ALTERNATIVE ONE IMPACT IDENTIFICATION TABLE

	THE IMMEDIATE VICINITY OF A WASTEWATER FACILITY	THE AREA IN SOUTHEASTERN MICHIGAN SERVED BY THE WASTEWATER SYSTEM	DIRECTLY AFFECTED AREAS OUTSIDE THE SERVICE AREA
I. WATER QUALITY			
A. SURFACE WATERS		Significant improvements could be expected in the water quality in the St. Clair, Clinton, Rouge, Huron, Detroit and Raisin Rivers due to elimination of urban stormwater and wastewater discharges.	
		Peak storm flows would be equalized in the Rouge, Huron and Clinton Rivers due to stormwater storage facilities.	
B. GROUND WATER	Ground water contamination would be minimized since treatment plant sludges would be incinerated prior to disposal.		
II. AQUATIC LIFE AND WATERFOWL		Habitats for intolerant game fish would be improved; however, artificial stocking would be required to maintain populations.	
III. PUBLIC HEALTH		Pathogen contamination from treatment plant effluents and uncontrolled discharge of urban storm runoff and combined sewer overflow would be *virtually eliminated*.	
		Infectious disease could be spread by waterfowl or other animals allowed access to stormwater storage lagoons.	
	A potential hazard would exist where large quantities of chlorine would be handled (On site chlorine production would significantly reduce the hazards).		
IV. ENERGY AND NATURAL RESOURCES A. AIR		Some gaseous (NO_X and SO_X) and particulate matter would be emmitted from incineration, lime sludge recalcination and carbon regeneration facilities at treatment plant sites.	
	A plume would be visible at incineration and lime sludge recalcination sites due to condensed water vapor.		
B. CHEMICALS		325,000 tons of chlorine (or raw materials, salt and electrical energy: 2600 kwhr/ton (Cl_2) would be consumed annually.	
		540,000 tons of lime (or raw materials, limestone rock and heat energy: 4.25-8.25 million BTU/ton lime) would be consumed annually.	
C. ELECTRICAL POWER		*The average electrical power demand of* 194 megawatts is within the planned capabilities of Detroit Edison.	
		The additional 1850 megawatts required for peak stormwater pumping would be met by stand-by generators which could also serve as emergency back-up to the regional power grid.	
D. FUEL OIL OR NATURAL GAS		31 billion BTU of heat energy from fuel oil or natural gas would be required daily.	

The comments in this table are intended to identify impacts only; each comment appears under the column identifying the area of greatest significance. The relative significance for other areas is identified by the screening indicated in the index to the right.

Equally Significant | **Somewhat Significant**

Partially Significant | **Insignificant**

THE REST OF THE STATE OF MICHIGAN	THE LAKE ERIE BASIN	THE NATION	CANADA – INTERNATIONAL
This plan would result in water of higher quality *than presently required* by the State of Michigan.		This plan meets the intent and time-phased goals of Public Law 92-500.	This plan would comply with the April 15 agreement with Canada on Great Lakes water quality.
	There is little potential for significant improvement in the western half of Lake Erie with respect to algal blooms and oxygen depletion.		
	If similar wastewater management projects were carried out in the remainder of the Lake Erie basin, ecological recovery may be possible in the eastern half of the lake.		
	Although the habitat for intolerant fishes would be improved in Lake Erie, improvement of fisheries will depend on management practices in the commercial fishing industry.		
	Waterfowl populations may improve due to improved habitats and food supplies.		

TABLE 7 (CONTINUED)
INDEPENDENT PHYSICAL-CHEMICAL TREATMENT ALTERNATIVE ONE
IMPACT IDENTIFICATION TABLE

	THE IMMEDIATE VICINITY OF A WASTEWATER FACILITY	THE AREA IN SOUTHEASTERN MICHIGAN SERVED BY THE WASTEWATER SYSTEM	DIRECTLY AFFECTED AREAS OUTSIDE THE SERVICE AREA
V. EMPLOYMENT		Labor demands for construction would cover a period of 10-12 years. The demands for that period would exceed the local supply thus requiring labor from outside the region.	
		Unemployment in the construction trades would be expected to drop with the advent of construction and increase upon completion of the project.	
		The total operating manpower required would be 2218. Special training programs would be necessary to meet demands for technicians and specialty labor categories.	
VI. LAND AND WATER USE CHANGES	Essentially all of the proposed facilities would somewhat alter existing and proposed land use. Impact on urbanized areas would minimized since major construction would occur at new sites allowing more freedom in site selection.		
		Buffer areas specified for most wastewater facilities have potential use by local units of government for open space or recreational areas.	
		Implementation of this plan would necessitate development of a supplementary water source for the Ann Arbor-Ypsilanti area to avoid abnormally low flows in the Huron River.	
	A potential would exist for developing local industrial water supplies utilizing renovated wastewater particularly in the vicinity of facilities near Adrian, Ypsilanti, Plymouth and the Huron River. Industrial expansion could thus be encouraged in areas previously not industrially oriented.		
VII. LAND VALUES		Land values along southeastern Michigan shorelines should increase due to improved water quality over the area and peak flow reduction in the Rouge and Clinton Rivers.	
	Some loss of property value may be experienced in the vicinity of wastewater management facilities due to the stigma associated with such facilities.		
VIII. AREA ECONOMY AND INSTITUTIONS		The history of growing intergovernmental cooperation in southeastern Michigan lays the basis for a regional approach to wastewater management.	
		Implementation and operation of this alternative would require one or several management organizations having a number of comprehensive management capabilities (i.e. planning, financing, construction, operation, maintenance and administrative capabilities).	
		Implementation of this plan would be contrary to the goals of some communities, particularly Ann Arbor, Pontiac and Warren, which desire to maintain autonomy.	
		27,0901 acres of land would be removed from the tax base of local and county governments.	
		All existing treatment facilities in the service area would be phased out by 1985.	
		The regional economy would be stimulated temporarily due to demands for construction materials and increased construction payrolls.	
		Gross income in the area would increase due to increased wastewater system payrolls; however, there would be an area-wide decrease in disposable income of each family due to increased sewer charges to offset costs shown under X. below.	
		The creation of an unpolluted water supply would not have a significant effect on existing economic enterprizes, nor is it apt to attract new types of economic activity.	

The comments in this table are intended to identify impacts only; each comment appears under the column identifying the area of greatest significance. The relative significance for other areas is identified by the screening indicated in the index to the right.

Equally Significant

Somewhat Significant

Partially Significant

Insignificant

THE REST OF THE STATE OF MICHIGAN	THE LAKE ERIE BASIN	THE NATION	CANADA - INTERNATIONAL

TABLE 7 (CONTINUED)
INDEPENDENT PHYSICAL-CHEMICAL TREATMENT ALTERNATIVE ONE
IMPACT IDENTIFICATION TABLE

	THE IMMEDIATE VICINITY OF A WASTEWATER FACILITY	THE AREA IN SOUTHEASTERN MICHIGAN SERVED BY THE WASTEWATER SYSTEM	DIRECTLY AFFECTED AREAS OUTSIDE THE SERVICE AREA
IX. SOCIOECONOMICS	Owners of economic establishments and residents of lands required for construction of wastewater facilities would have to be relocated.		
	Residents of lands near proposed facilities would have their normal lifestyle disrupted and commercial enterprizes near-by would be affected while construction operations were underway.		
		The system would help satisfy a regional need for expanded water based recreation by providing more waters suitable for total body contact recreation.	
X. SYSTEM COSTS			
A. CAPITAL COSTS		$1,066,000,000	
B. AMORTIZED CAPITAL COST (Average annual)		63,000,000	
C. OPERATION AND MAINTENANCE (Average annual)		124,000,000	
D. TOTAL AVERAGE ANNUAL COST		187,000,000	

The comments in this table are intended to identify impacts only; each comment appears under the column identifying the area of greatest significance. The relative significance for other areas is identified by the screening indicated in the index to the right.

Equally Significant

Somewhat Significant

Partially Significant

Insignificant

THE REST OF THE STATE OF MICHIGAN	THE LAKE ERIE BASIN	THE NATION	CANADA – INTERNATIONAL
		$3,197,000,000 189,000,000 189,000,000	

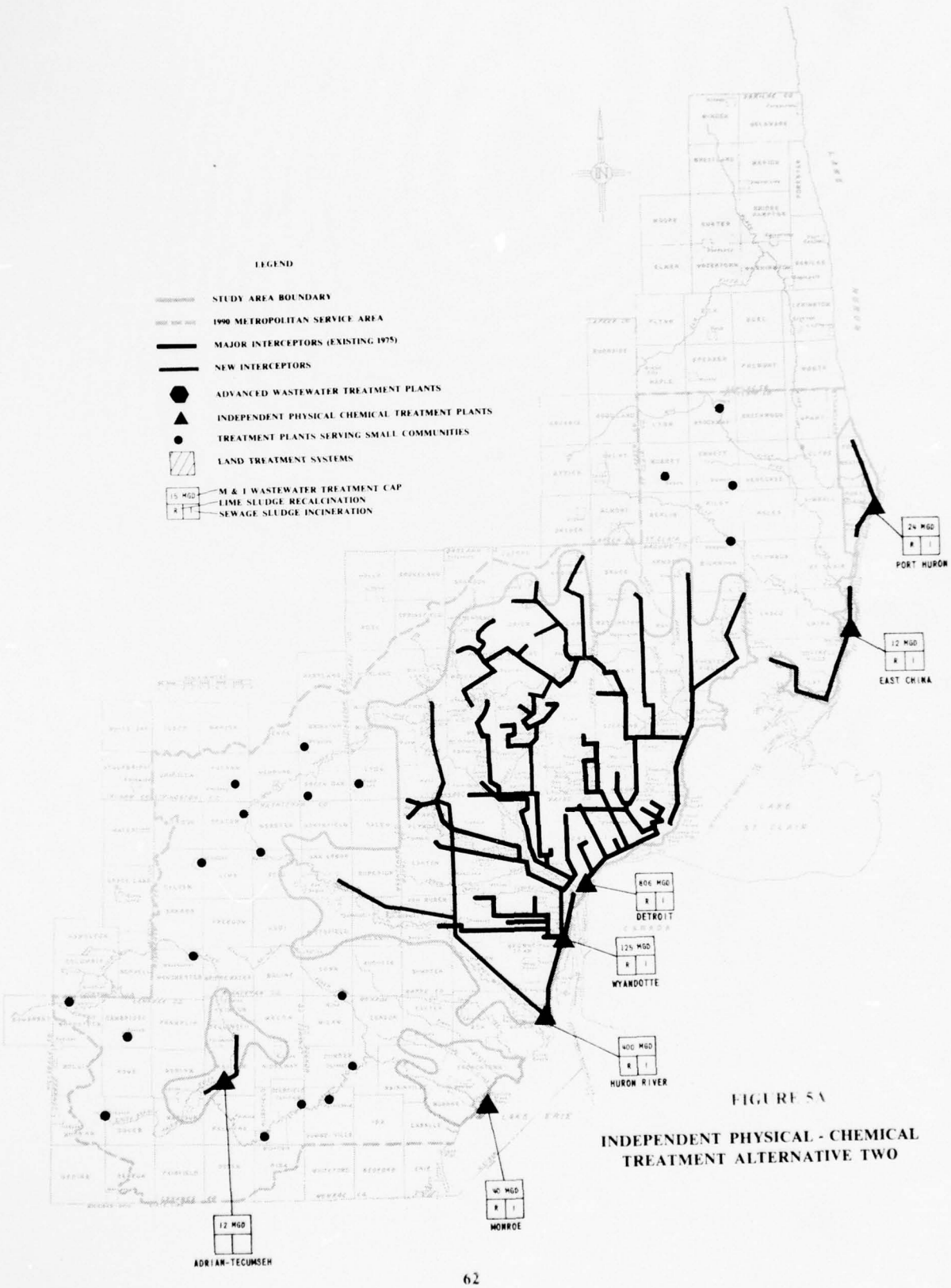


FIGURE 5A

INDEPENDENT PHYSICAL - CHEMICAL
TREATMENT ALTERNATIVE TWO

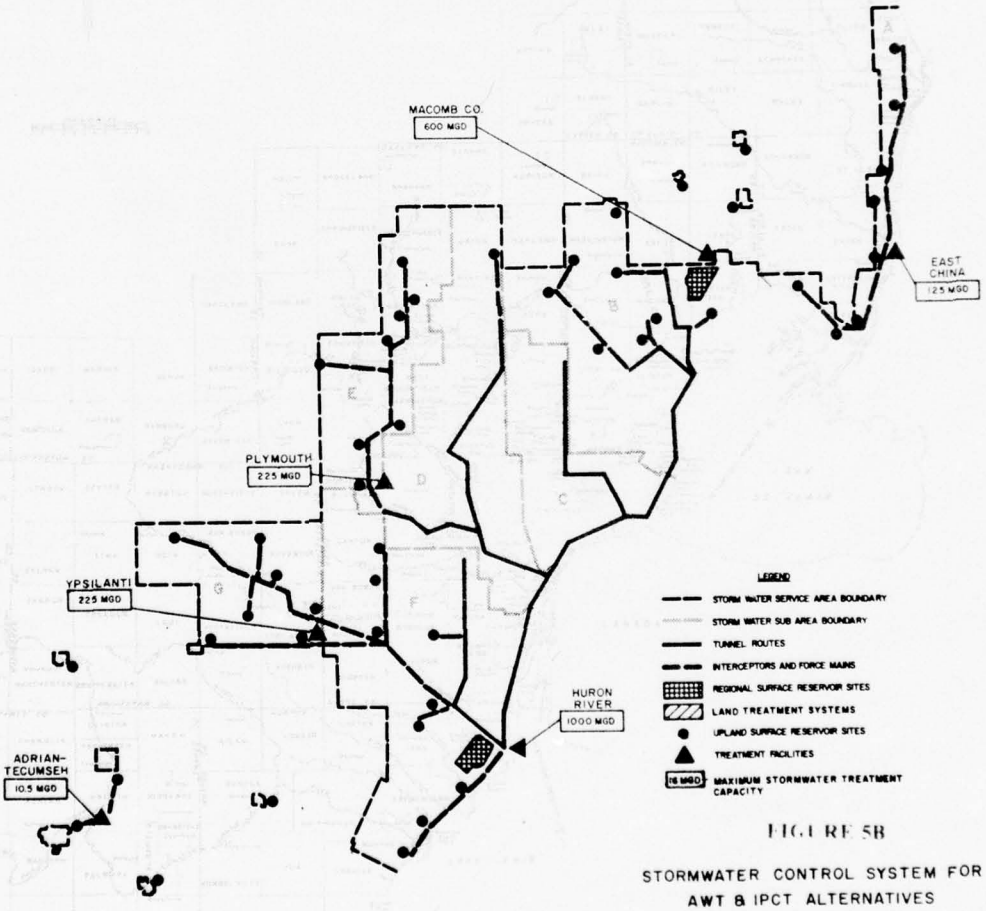


FIGURE 5B

STORMWATER CONTROL SYSTEM FOR AWT & IPCT ALTERNATIVES

Treatment Plants	970 Acres
Stormwater Storage	23,500 Acres
Sludge and ash disposal (50 years)	3,431 Acres

Independent Physical-Chemical Treatment Alternative Two

Like IPCT Alternative One, this alternative utilizes independent physical-chemical treatment as the primary method for treatment of both municipal-industrial wastewater and storm runoff. Sludges generated during treatment would be incinerated and recalcined lime reused. Unlike IPCT Alternative One, this alternative would emphasize use of existing regional facilities at Port Huron, Detroit, Wyandotte and Monroe by converting these plants to the IPCT process (see figure 5A).

Municipal-industrial wastewater would be treated at Port Huron, East China, Detroit, Wyandotte, Monroe, near the mouth of the Huron River and east of Adrian. The interceptor system required for this alternative would be the same as that previously presented for AWT Alternatives One and Two. Communities outside the area served by the regional plants would operate small advanced treatment plants until growth would justify extension of regional interceptors.

The stormwater collection, storage and treatment system would be the same as described in the previously presented alternatives. Treatment facilities would be located at the sites of the three municipal-industrial treatment plants at East China, the Huron River and Adrian, and at Plymouth, Ypsilanti and Macomb County (see figure 5B).

Wastewater treatment sludges would be incinerated; recalcined lime would be reused; and waste ash would be disposed of by landfill. The largest quantities of waste solids would be taken from stormwater storage facilities. The storm solids would be allowed to dry and landfilled.

TABLE 8
INDEPENDENT PHYSICAL-CHEMICAL TREATMENT ALTERNATIVE TWO
IMPACT IDENTIFICATION TABLE

	THE IMMEDIATE VICINITY OF A WASTEWATER FACILITY	THE AREA IN SOUTHEASTERN MICHIGAN SERVED BY THE WASTEWATER SYSTEM	DIRECTLY AFFECTED AREAS OUTSIDE THE SERVICE AREA
I. WATER QUALITY			
A. SURFACE WATERS		Significant improvements could be expected in the water quality in the St. Clair, Clinton, Rouge, Huron, Detroit and Raisin Rivers due to elimination of urban stormwater and wastewater discharges.	
		Peak storm flows would be equalized in the Rouge, Huron and Clinton Rivers due to stormwater storage facilities.	
B. GROUND WATER	*Ground water contamination would be minimized* since treatment plant sludges would be incinerated prior to disposal.		
II. AQUATIC LIFE AND WATERFOWL		Habitats for intolerant game fish would be improved; however, artificial stocking would be required to maintain populations.	
III. PUBLIC HEALTH		Pathogen contamination from treatment plant effluents and uncontrolled discharge of urban storm runoff and combined sewer overflow would be virtually eliminated.	
		Infectious disease could be spread by waterfowl or other animals allowed access to stormwater storage lagoons.	
	A potential hazard would exist where large quantities of chlorine would be handled (On site chlorine production would significantly reduce the hazards).		
IV. ENERGY AND NATURAL RESOURCES A. AIR		Some gaseous (NO_X and SO_X) and particulate matter would be emmitted from incineration, lime sludge *recalcination and carbon regeneration* facilities at treatment plant sites.	
	A plume would be visible at incineration and lime sludge recalcination sites due to condensed water *vapor*.		
B. CHEMICALS		325,000 tons of chlorine (or raw materials, salt and electrical energy: 2600 kwhr/ton Cl_2) would be consumed annually.	
		541,000 tons of lime (or raw materials, limestone rock and heat energy: 4.25-8.25 million BTU/ton lime) would be consumed annually.	
C. ELECTRICAL POWER		The average electrical power demand of 184 megawatts is within the planned capabilities of Detroit Edison.	
		The additional 1850 megawatts required for peak stormwater pumping would be met by stand-by generators which could also serve as emergency back-up to the regional power grid.	
D. FUEL OIL OR NATURAL GAS		31 billion BTU of heat energy from fuel oil or natural gas would be required daily.	

The comments in this table are intended to identify impacts only; each comment appears under the column identifying the area of greatest significance. The relative significance for other areas is identified by the screening indicated in the index to the right.

Equally Significant

Somewhat Significant

Partially Significant

Insignificant

THE REST OF THE STATE OF MICHIGAN	THE LAKE ERIE BASIN	THE NATION	CANADA - INTERNATIONAL
This plan would result in water of higher quality than presently required by the State of Michigan.		*This plan meets* the intent and time phased goals of Public Law 92-500.	This plan would comply with the April 1972 agreement with Canada on Great Lakes water quality.
	There is little potential for significant improvement in the western half of Lake Erie with respect to algal blooms and oxygen depletion.		
	If similar wastewater management projects were carried out in the remainder of the Lake Erie basin, ecological recovery may be possible in the eastern half of the lake.		
	Although the habitat for intolerant fishes would be improved in Lake Erie, improvement of fisheries will depend on management practices in the commercial fishing industry.		
	Waterfowl populations may improve due to improved habitats and food supplies.		

TABLE 8 (CONTINUED)
INDEPENDENT PHYSICAL-CHEMICAL TREATMENT ALTERNATIVE TWO
IMPACT IDENTIFICATION TABLE

	IN THE IMMEDIATE VICINITY OF A WASTEWATER FACILITY	IN THE AREA IN SOUTHEASTERN MICHIGAN SERVED BY THE WASTEWATER SYSTEM	DIRECTLY AFFECTED AREAS OUTSIDE THE SERVICE AREA
V. EMPLOYMENT		Labor demands for construction would cover a period of 10-12 years. The demands for that period would exceed the local supply thus requiring labor from outside the region.	
		Unemployment in the construction trades would be expected to drop with the advent of construction and increase upon completion of the project.	
		The total operating manpower required would be 229. Special training programs would be necessary to meet demands for technicians and specialty labor categories.	
VI. LAND AND WATER USE CHANGES	Essentially all the proposed facilities would somewhat alter existing land use. The use of the IPCT process would minimize land requirements for treatment facilities.		
		Buffer areas specified for most wastewater facilities have potential use by local units of government for open space or recreational areas.	
		Implementation of this plan would necessitate development of a supplementary water source for the Ann Arbor-Ypsilanti area to avoid abnormally low flows in the Huron River.	
VII. LAND VALUES	A potential would exist for developing local industrial water supplies utilizing renovated wastewater particularly in the vicinity of facilities near Adrian, Ypsilanti, Plymouth and the Huron River. Industrial expansion could thus be encouraged in areas previously not industrially oriented.		
		Land values along southeastern Michigan shorelines should increase due to improved water quality over the area and peak flow reduction in the Rouge and Clinton Rivers.	
	Some loss of property value may be experienced in the vicinity of wastewater management facilities due to the stigma associated with such facilities.		
VIII. AREA ECONOMY AND INSTITUTIONS		The history of growing intergovernmental cooperation in southeastern Michigan lays the basis for a regional approach to wastewater management.	
		Implementation and operation of this alternative would require one or several management organizations having a number of comprehensive management capabilities (i.e. planning, financing, construction, operation, maintenance and administrative capabilities).	
		Implementation of this plan would be contrary to the goals of some communities, particularly Ann Arbor, Pontiac and Warren, which desire to maintain autonomy.	
		27,925 acres of land would be removed from the tax base of local and county governments.	
		All existing treatment facilities in the service area with the exception of Detroit, Wyandotte, Port Huron and Monroe would be phased out by 1985.	
		The regional economy would be stimulated temporarily due to demands for construction materials and increased construction payrolls.	
		Gross income in the area would increase due to increased wastewater system payrolls; however, there would be an area-wide decrease in disposable income of each family due to increased sewer charges to offset costs shown under X. below.	
		The creation of an unpolluted water supply would not have a significant effect on existing economic enterprizes, nor is it apt to attract new types of economic activity.	

The comments in this table are intended to identify impacts only; each comment appears under the column identifying the area of greatest significance. The relative significance for other areas is identified by the screening indicated in the index to the right.

Equally Significant

Somewhat Significant

Partially Significant

Insignificant

THE REST OF THE STATE OF MICHIGAN	THE LAKE ERIE BASIN	THE NATION	CANADA - INTERNATIONAL

TABLE 8 (CONTINUED)
INDEPENDENT PHYSICAL-CHEMICAL TREATMENT ALTERNATIVE TWO
IMPACT IDENTIFICATION TABLE

	THE IMMEDIATE VICINITY OF A WASTEWATER FACILITY	THE AREA IN SOUTHEASTERN MICHIGAN SERVED BY THE WASTEWATER SYSTEM	*DIRECTLY AFFECTED AREAS OUTSIDE* THE SERVICE AREA
IX. SOCIO-ECONOMICS	Owners of economic establishments and residents of lands required for construction of wastewater facilities would have to be relocated.		
	Residents of lands near proposed facilities would have their normal lifestyle disrupted and commercial *enterprizes near-by would be affected* while construction operations were underway.		
		The system would help satisfy a regional need for expanded water based recreation by providing more waters suitable for total body contact recreation.	
X. SYSTEM COSTS			
A. CAPITAL COSTS		$1,910,000,000	
B. AMORTIZED CAPITAL COST (Average annual)		60,000,000	
C. OPERATION AND MAINTENANCE (Average annual)		119,000,000	
D. TOTAL AVERAGE ANNUAL COST		179,000,000	

The comments in this table are intended to identify impacts only; each comment appears under the column identifying the area of greatest significance. The relative significance for other areas is identified by the screening indicated in the index to the right.

Equally Significant

Somewhat Significant

Partially Significant

Insignificant

THE REST OF THE STATE OF MICHIGAN	THE LAKE ERIE BASIN	THE NATION	CANADA – INTERNATIONAL
		$3,030,000,000 179,000,000 179,000,000	

Costs, energy and chemical requirements for the system are covered in the impact table (Table 8). The additional land required for the system is also an important consideration. Total land needs by type of operation are:

Treatment Plants	897 Acres
Stormwater Storage	23,500 Acres
Sludge and Ash Disposal (50 years)	3,528 Acres

Independent Physical-Chemical Alternative Three

This alternative is identical to IPCT Alternative Two (figures 5A & 5B) with the exception that no incineration processes would be employed for sludge disposal. This would result in a large increase in sludge volume for disposal and a subsequent increase in land required for sludge disposal. Also lime reuse would not be possible. The advantages gained at the cost of the additional land and chemical demand would be thy elimination of a potential air emission source and a significant reduction in energy consumption.

Costs, energy and chemical requirements for the system can be found in the impact table (Table 9). The additional land required for implementation of this alternative is listed below by type of intended use:

Treatment Plants	897 Acres
Stormwater Storage	23,500 Acres
Sludge Disposal (50 years)	15,971 Acres

Land Irrigation Treatment Alternative One

This alternative would utilize land irrigation treatment as the primary method of municipal-industrial wastewater and storm runoff treatment. The alternative would make maximum use of the recyclable constituents of

TABLE 9
INDEPENDENT PHYSICAL-CHEMICAL TREATMENT ALTERNATIVE THREE
IMPACT IDENTIFICATION TABLE

	THE IMMEDIATE VICINITY OF A WASTEWATER FACILITY	THE AREA IN SOUTHEASTERN MICHIGAN SERVED BY THE WASTEWATER SYSTEM	DIRECTLY AFFECTED AREAS OUTSIDE THE SERVICE AREA
I. WATER QUALITY			
A. SURFACE WATERS		Significant improvements could be expected in the water quality in the St. Clair, Clinton, Rouge, Huron, Detroit and Raisin Rivers due to elimination of urban stormwater and wastewater discharges.	
		Peak storm flows would be equalized in the Rouge, Huron and Clinton Rivers due to stormwater storage facilities.	
B. GROUND WATER	Ground water contamination could result if sludge landfills in St. Clair and Lenawee Counties were not properly operated (primary contaminants: nitrates & heavy metals).		
II. AQUATIC LIFE AND WATERFOWL		Habitats for intolerant game fish would be improved; however, artificial stocking would be required to maintain populations.	
III. PUBLIC HEALTH		Pathogen contamination from treatment plant effluents and uncontrolled discharge of urban storm runoff and combined sewer overflow would be virtually eliminated.	
		Infectious disease could be spread by waterfowl or other animals allowed access to stormwater storage lagoons.	
	A potential hazard would exist where large quantities of chlorine would be handled (On site chlorine production would significantly reduce the hazards).		
IV. ENERGY AND NATURAL RESOURCES A. AIR		Some gaseous (NO_X and SO_X) and particulate matter would be emmitted from carbon regeneration facilities. All other combustion processes have been eliminated.	
B. CHEMICALS		325,000 tons of chlorine (or raw materials, salt and electrical energy: 2600 Kwhr/ton Cl_2) would be consumed annually.	
		1,007,000 tons of lime (or raw materials, limestone rock and heat energy: 4.25-8.25 million BTU/ton lime) would be consumed annually.	
C. ELECTRICAL POWER		The average electrical power demand of 141 megawatts is within the planned capabilities of Detroit Edison.	
		The additional 1850 megawatts required for peak stormwater pumping would be met by stand-by generators which could also serve as emergency back-up to the regional power grid.	
D. FUEL OIL OR NATURAL GAS		7 billion BTU of heat energy from fuel oil or natural gas would be required daily.	
V. EMPLOYMENT		Labor demands for construction would cover a period of 10-12 years. The demands for that period would exceed the local supply thus requiring labor from outside the region.	

The comments in this table are intended to identify impacts only; each comment appears under the column identifying the area of greatest significance. The relative significance for other areas is identified by the screening indicated in the index to the right.

Equally Significant

Somewhat Significant

Partially Significant

Insignificant

THE REST OF THE STATE OF MICHIGAN	THE LAKE ERIE BASIN	THE NATION	CANADA - INTERNATIONAL
This plan would result in water of higher quality than presently required by the State of Michigan.		This plan meets the intent and time-phased goals of Public Law 92-500.	This plan would comply with the April 1972 agreement with Canada on Great Lakes water quality.
	There is little potential for significant improvement in the western half of Lake Erie with respect to algal blooms and oxygen depletion.		
	If similar wastewater management projects were carried out in the remainder of the Lake Erie basin, ecological recovery may be possible in the eastern half of the lake.		
	Although the habitat for intollerant fishes would be improved in Lake Erie, improvement of fisheries will depend on management practices in the commercial fishing industry.		
	Waterfowl populations may improve due to improved habitats and food supplies.		

TABLE 9 (CONTINUED)
INDEPENDENT PHYSICAL-CHEMICAL TREATMENT ALTERNATIVE THREE
IMPACT IDENTIFICATION TABLE

	THE IMMEDIATE VICINITY OF A WASTEWATER FACILITY	THE AREA IN SOUTHEASTERN MICHIGAN SERVED BY THE WASTEWATER SYSTEM	DIRECTLY AFFECTED AREAS OUTSIDE THE SERVICE AREA
		Unemployment in the construction trades would be expected to drop with the advent of construction and increase upon completion of the project.	
		The total operating manpower required would be 2436. Special training programs would be necessary to meet demands for technicians and specialty labor categories.	
VI. LAND AND WATER USE CHANGES	Essentially all the proposed facilities would somewhat alter existing land use. The use of the IPCT process would minimize land requirements for treatment facilities.		
		Buffer areas specified for most wastewater facilities have potential use by local units of government for open space or recreational areas.	
		Implementation of this plan would necessitate development of a supplementary water source for the Ann Arbor-Ypsilanti area to avoid abnormally low flows in the Huron River.	
	A potential would exist for developing local industrial water supplies utilizing renovated wastewater particularly in the vicinity of facilities near Adrian, Ypsilanti, Plymouth and the Huron River. Industrial expansion could thus be encouraged in areas previously not industrially oriented.		
VII. LAND VALUES		Land values along southeastern Michigan shorelines should increase due to improved water quality over the area and peak flow reduction in the Rouge and Clinton Rivers.	
	Some loss of property value may be experienced in the vicinity of wastewater management facilities due to the stigma associated with such facilities.		
VIII. AREA ECONOMY AND INSTITUTIONS		The history of growing intergovernmental cooperation in southeastern Michigan lays the basis for a regional approach to wastewater management.	
		Implementation and operation of this alternative would require one or several management organizations having a number of comprehensive management capabilities (i.e. planning, financing, construction, operation, maintenance and administrative capabilities).	
		Implementation of this plan would be contrary to the goals of some communities, particularly Ann Arbor, Pontiac and Warren, which desire to maintain autonomy.	
		40,188 acres of land would be removed from the tax base of local and county governments.	
		All existing treatment facilities in the service area with the exception of Detroit, Wyandotte, Port Huron and Monroe would be phased out by 1985.	
		The regional economy would be stimulated temporarily due to demands for construction materials and increased construction payrolls.	
		Gross income in the area would increase due to increased wastewater system payrolls; however, there would be an area-wide decrease in disposable income of each family due to increased sewer charges to offset costs shown under X. below.	
		The creation of an unpolluted water supply would not have a significant effect on existing economic enterprizes, nor is it apt to attract new types of economic activity.	
IX. SOCIO-ECONOMICS	Owners of economic establishments and residents of lands required for construction of wastewater facilities would have to be relocated.		

The comments in this table are intended to identify impacts only; each comment appears under the column identifying the area of greatest significance. The relative significance for other areas is identified by the screening indicated in the index to the right.

Equally Significant

Somewhat Significant

Partially Significant

Insignificant

THE REST OF THE STATE OF MICHIGAN	THE LAKE ERIE BASIN	THE NATION	CANADA - INTERNATIONAL

TABLE 9 (CONTINUED)
INDEPENDENT PHYSICAL-CHEMICAL TREATMENT ALTERNATIVE THREE
IMPACT IDENTIFICATION TABLE

	THE IMMEDIATE VICINITY OF A WASTEWATER FACILITY	THE AREA IN SOUTHEASTERN MICHIGAN SERVED BY THE WASTEWATER SYSTEM	DIRECTLY AFFECTED AREAS OUTSIDE THE SERVICE AREA
	Residents of lands near proposed facilities would have their normal lifestyle disrupted and commercial enterprizes near-by would be affected while construction operations were underway.		
		The system would help satisfy a regional need for expanded water based recreation by providing more waters suitable for total body contact recreation.	
V. SYSTEM COSTS			
A. CAPITAL COSTS		$997,000,000	
B. AMORTIZED CAPITAL COST (Average annual)		59,000,000	
C. OPERATION AND MAINTENANCE (Average annual)		111,000,000	
D. TOTAL AVERAGE ANNUAL COST		170,000,000	

The comments in this table are intended to identify impacts only; each comment appears under the column identifying the area of greatest significance. The relative significance for other areas is identified by the screening indicated in the index to the right.

Equally Significant 

Somewhat Significant 

Partially Significant 

Insignificant 

THE REST OF THE STATE OF MICHIGAN	THE LAKE ERIE BASIN	THE NATION	CANADA - INTERNATIONAL
		$2,990,000,000 177,000,000 177,000,000	

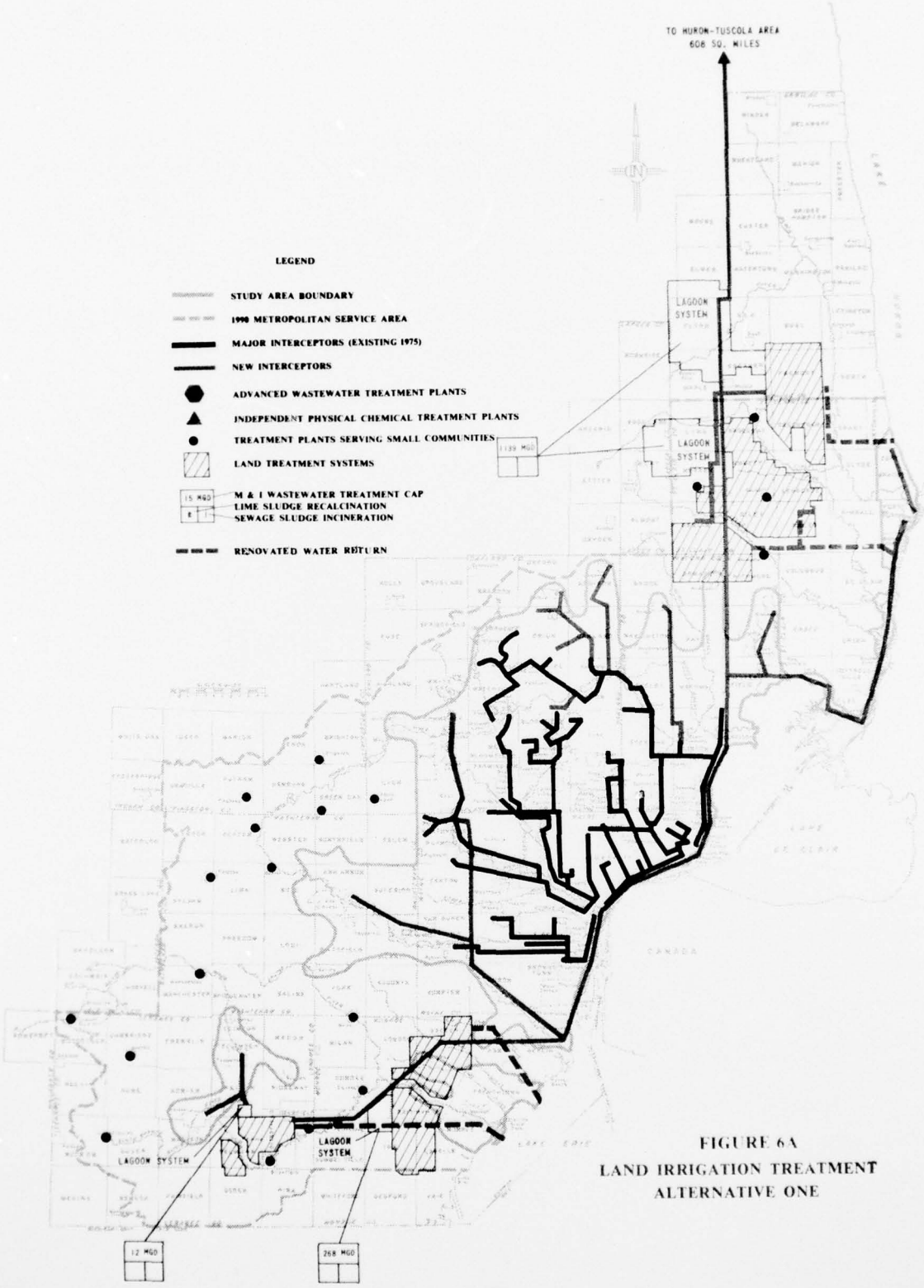


FIGURE 6A
LAND IRRIGATION TREATMENT
ALTERNATIVE ONE

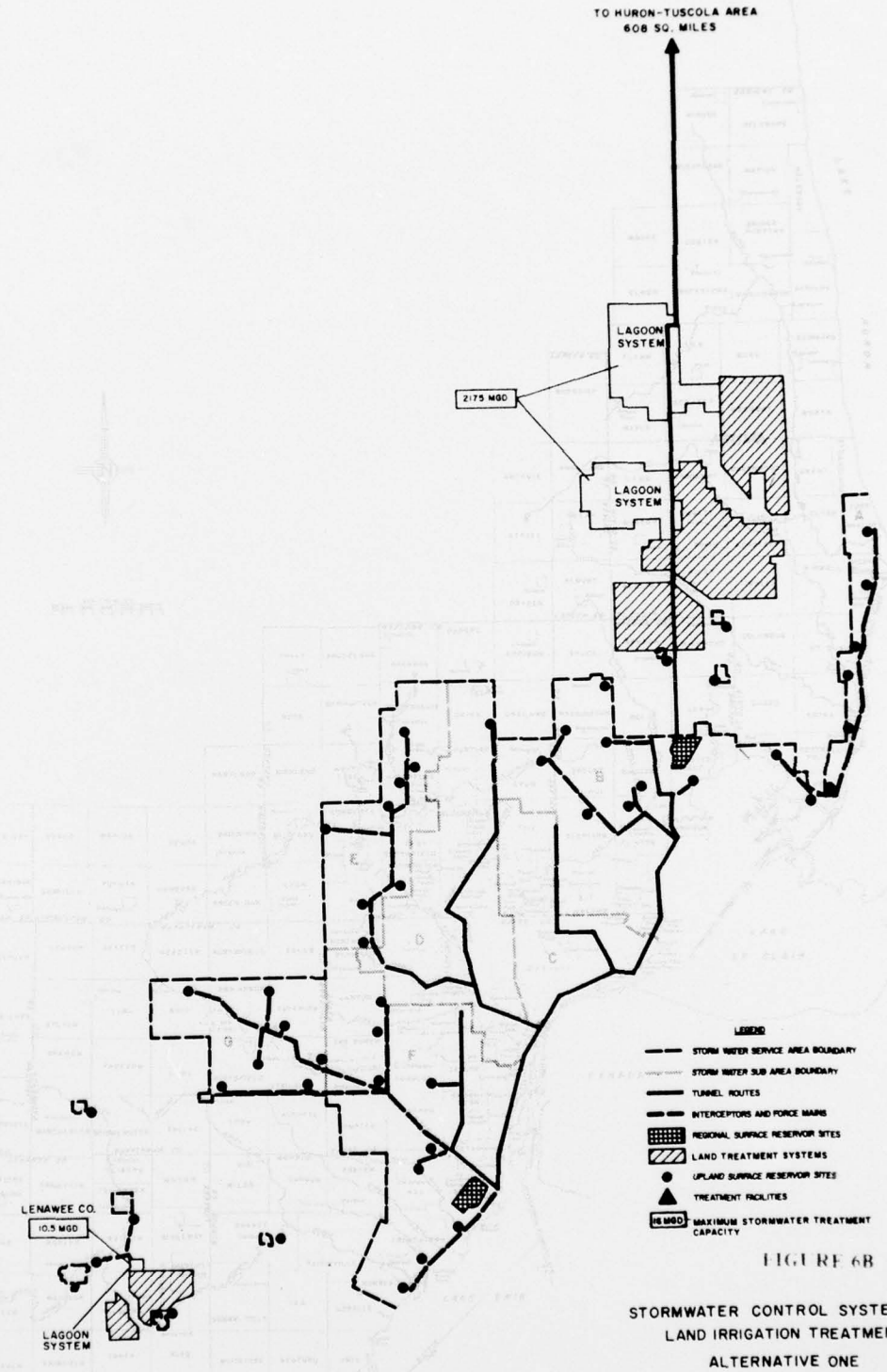


FIGURE 6B

STORMWATER CONTROL SYSTEM FOR
LAND IRRIGATION TREATMENT
ALTERNATIVE ONE

wastewater by applying both treated wastewater and wastewater sludges to land for agricultural production. This would, however, require abandonment of all existing wastewater treatment facilities.

A mixture of municipal-industrial wastewater and storm runoff would receive an equivalent of secondary treatment at two major aerated lagoon systems in Monroe and St. Clair Counties and a smaller system in Lenawee County (see figures 6A & 6B). At the lagoon sites, storage would be provided for all wastewater for a period of 155 days since wastewater would not be applied to the land during winter months and wet periods. Treated wastewater would be chlorinated for disinfection and applied to the land areas shown in the figure. After percolation through the soil, renovated wastewater would be collected in an underdrain system and either discharged to local streams for flow augmentation or transported to major rivers for discharge.

Wastewater would be transported to the treatment lagoons from a major transmission tunnel paralleling the Lake St. Clair, Detroit River, and Lake Erie shoreline. Major interceptors from Ann Arbor along the Huron River and from the Huron River north along Hanna Road would be required to complete the Detroit regional municipal-industrial interceptor system. A second interceptor system paralleling the St. Clair River would serve St. Clair County.

The system for collection and storage of storm runoff would be independent of the municipal-industrial wastewater system until the stormwater system would discharge to the Detroit River transmission tunnel. The stormwater storage system would consist of forty-nine community reservoirs ranging from 80 to 690 acres in size. Two regional reservoirs of 3,120 acres would be located at each end of the Detroit River transmission tunnel.

Sludges generated at the aerated lagoons would be dredged from settling lagoons and applied to land adjacent to the lagoon site. Sludge

TABLE 10
LAND IRRIGATION TREATMENT ALTERNATIVE ONE
IMPACT IDENTIFICATION TABLE

	THE IMMEDIATE VICINITY OF A WASTEWATER FACILITY	THE AREA IN SOUTHEASTERN MICHIGAN SERVED BY THE WASTEWATER SYSTEM	DIRECTLY AFFECTED AREAS OUTSIDE THE SERVICE AREA
I. WATER QUALITY			
A. SURFACE WATERS		Significant improvements could be expected in the water quality in the St. Clair, Clinton, Rouge, Huron, Detroit and Raisin Rivers due to elimination of urban stormwater and wastewater discharges.	
		Peak storm flows would be equalized in the Rouge, Huron and Clinton Rivers due to stormwater storage facilities.	
			An increase in stream baseflow may be experienced in areas under irrigation.
B. GROUND WATER	Some water from irrigated areas may reach ground waters but would only affect quantity not quality.		
	Ground water contamination could result from poorly managed sludge application areas and sludge landfills (primarily nitrates and heavy metals).		
II. AQUATIC LIFE AND WATERFOWL		Habitats for intolerant game fish would be improved; however, artificial stocking would be required to maintain populations.	
III. PUBLIC HEALTH		Pathogen contamination from treatment plant effluents and uncontrolled discharge of urban storm runoff and combined sewer overflow would be virtually eliminated.	
			Infectious disease could be spread by waterfowl or game animals allowed access to stormwater storage lagoons, wastewater treatment and storage lagoons, sludge disposal areas, and wastewater conveyance ditches.
	A *potential hazard would exist where large* quantities of chlorine would be handled (On site chlorine production would significantly reduce the hazards).		
			Increased concentrations of pathogens could be expected in the air in the vicinity of aerated lagoons and in irrigations areas.
IV. ENERGY AND NATURAL RESOURCES A. AIR		Sewage sludge incineration would be eliminated as a source of atmospheric pollution.	
B. CHEMICALS		43,000 tons of chlorine (or raw materials, salt and electrical energy: 2600 kwhr/ton Cl_2) would be consumed annually.	
		Phosphorus and nitrogen in the irrigated wastewater would be recycled into the environment, reducing the need for commercial fertilizers.	
C. ELECTRICAL POWER		The average electrical power demand of 1142 megawatts would exceed the planned generating *capacity of Detroit Edison* (1972 generating capacity: 7,039 mw.).	

The comments in this table are intended to identify impacts only; each comment appears under the column identifying the area of greatest significance. The relative significance for other areas is identified by the screening indicated in the index to the right.

Equally Significant

Somewhat Significant

Partially Significant

Insignificant

THE REST OF THE STATE OF MICHIGAN	THE LAKE ERIE BASIN	THE NATION	CANADA - INTERNATIONAL
This plan would result in water of higher quality than presently required by the State of Michigan.		This plan meets the intent and time-phased goals of Public Law 92-500.	This plan would comply with the April 1972 agreement with Canada on Great Lakes water quality.
	There is little potential for significant improvement in the western half of Lake Erie with respect to algal blooms and oxygen depletion.		
	This alternative offers the greatest potential for ecological recovery in the eastern half of Lake Erie but would depend upon implementation of similar plans throughout the basin.		
	Although the habitat for intolerant fishes would be improved in Lake Erie, improvement of fisheries will depend on management practices in the commercial fishing industry.		
	Waterfowl populations may improve due to improved habitats and food supplies.		

TABLE 10 (CONTINUED)
LAND IRRIGATION TREATMENT ALTERNATIVE ONE
IMPACT IDENTIFICATION TABLE

	THE IMMEDIATE VICINITY OF A WASTEWATER FACILITY	THE AREA IN SOUTHEASTERN MICHIGAN SERVED BY THE WASTEWATER SYSTEM	DIRECTLY AFFECTED AREAS OUTSIDE THE SERVICE AREA
		The additional 1850 megawatts required for peak stormwater pumping would be met by stand-by generators which could also serve as emergency back-up to the regional power grid.	
D. FUEL OIL OR NATURAL GAS		Fuel oil for operation of trucks and tractors would total less than 1 billion BTU per day.	
V. EMPLOYMENT		*Labor demands for construction* would cover a period of 10-12 years. The demands for that period would exceed the local supply thus requiring labor from outside the region.	
		Unemployment in the construction trades would be expected to drop with the advent of construction and increase upon completion of the project.	
		Operating manpower for the system, not including the manpower required for farming operations, would be 1775 men.	
			There would be a dramatic shift in employment in the areas to be irrigated and a potentially large rise in unemployment in those areas.
VI. LAND AND WATER USE CHANGES	Land use would be most markedly changed by construction of stormwater storage facilities in and around the urbanized area (23,500 acres) and by construction of treatment and storage lagoons in St. Clair (28,000 acres), Lapeer (14,000 acres), Sanilac (56,000 acres), and Monroe (14,000 acres) Counties.		
		Buffer areas specified for most wastewater facilities have *potential* use by *local units of government* for open space or recreational areas.	
		Implementation of this plan would necessitate development of a supplementary water source for the Ann Arbor-Ypsilanti area to avoid abnormally *low flows in the Huron River.*	
	A potential would exist for developing the lagoon systems in St. Clair and Monroe Counties for use as industrial cooling water for power generation or similar operations.		
VII. LAND VALUES		Land values along southeastern Michigan shorelines should increase due to improved water quality over the area and peak flow reduction in the Rouge and Clinton Rivers.	
	Some loss of property value may be experienced in the vicinity of wastewater management facilities due to the stigma associated with such facilities.		
			Although an increase in gross productivity of the irrigated land could be expected, land removed from production for treatment and storage lagoons could result in no net increase in total production.
			Forage type crops to be produced on lands under irrigation would displace any cash crops previously grown.
VIII. AREA ECONOMY AND INSTITUTIONS		The history of growing intergovernmental cooperation in southeastern Michigan lays the basis for a regional approach to wastewater management.	
		Implementation and operation of this alternative would require one or several management organizations having a number of comprehensive management capabilities (i.e. planning, financing, construction, operation, maintenance and administrative capabilities).	
		Implementation of this plan would be contrary to the goals of some communities, particularly Ann Arbor, Pontiac and Warren, which desire to maintain autonomy.	

The comments in this table are intended to identify impacts only; each comment appears under the column identifying the area of greatest significance. The relative significance for other areas is identified by the screening indicated in the index to the right.

Equally Significant

Somewhat Significant

Partially Significant

Insignificant

THE REST OF THE STATE OF MICHIGAN	THE LAKE ERIE BASIN	THE NATION	CANADA - INTERNATIONAL*

TABLE 10 (CONTINUED)
LAND IRRIGATION TREATMENT ALTERNATIVE ONE
IMPACT IDENTIFICATION TABLE

	THE IMMEDIATE VICINITY OF A WASTEWATER FACILITY	THE AREA IN SOUTHEASTERN MICHIGAN SERVED BY THE WASTEWATER SYSTEM	DIRECTLY AFFECTED AREAS OUTSIDE THE SERVICE AREA
			736,000 acres of land would be removed from the tax base of local and county governments. The major effects would be felt in St. Clair, Monroe, Huron and Tuscola Counties.
		All existing treatment facilities in the service area would be phased out by 1985.	
		The regional economy would be stimulated temporarily due to demands for construction materials and increased construction payrolls.	
		Gross income in the area would increase due to increased wastewater system payrolls; however, there would be an area-wide decrease in disposable income of each family due to increased sewer charges to offset costs shown under X. below.	
		The creation of an unpolluted water supply would not have a significant effect on existing economic enterprizes, nor is it apt to attract new types of economic activity.	
			Replacement of small farms with large commercial type operations could alter local distribution channels for farm machinery, seed, fertilizer, and crops.
IX. SOCIO-ECONOMICS	Owners of economic establishments and residents of lands required for construction of wastewater facilities would have to be relocated.		
	Residents of lands near proposed facilities would have their normal lifestyle disrupted and commercial enterprizes near-by would be affected while construction operations were underway.		
		The system would help satisfy a regional need for expanded water based recreation by providing more waters suitable for total body contact recreation.	
X. SYSTEM COSTS			
A. CAPITAL COSTS		$1,507,000,000	
B. AMORTIZED CAPITAL COST (Average annual)		89,000,000	
C. OPERATION AND MAINTENANCE (Average annual)		165,000,000	
D. TOTAL AVERAGE ANNUAL COST		254,000,000	

The comments in this table are intended to identify impacts only; each comment appears under the column identifying the area of greatest significance. The relative significance for other areas is identified by the screening indicated in the index to the right.

Equally Significant

Somewhat Significant

Partially Significant

Insignificant

THE REST OF THE STATE OF MICHIGAN	THE LAKE ERIE BASIN	THE NATION	CANADA - INTERNATIONAL
		$4,521,000,000 270,000,000 – – 270,000,000	

from stormwater storage lagoons would be removed dry and landfilled.

Costs and energy and chemical demands for the system are covered in the impact table (Table 10). To insure the management control necessary for concentrated application of wastewater, it was assumed that all irrigation land would be purchased by the implementing agency. The total land requirements of the system by type of operation are:

Stormwater storage system	23,500 Acres
Treatment and storage lagoons	71,601 Acres
Land application of sludge	41,476 Acres
Irrigation	597,530 Acres
Sludge Landfill (50 years)	1,960 Acres

Land Irrigation Treatment Alternative Two

This alternative would use land irrigation treatment as the primary method of municipal-industrial wastewater treatment. The majority of the storm runoff would be treated by the IPCT process. This alternative would make use of the recyclable constituents from those wastewaters having greatest concentrations of the desirable constituents, and would treat less concentrated wastes in wastewater plants. The alternative would still result in abandonment of the existing wastewater treatment facilities.

Municipal-industrial wastewater would be handled as indicated in Land Alternative One; however, since stormwater would be treated in a separate system, the land requirements for treatment and storage lagoons and irrigation are significantly less (see figures 7A & 7B). The collection and transmission system would change somewhat since storm and municipal-industrial wastewater separation would be maintained. A major transmission tunnel would be required from the site of the existing Detroit plant north to the St. Clair County lagoon site. The northern portion of the Hanna Road interceptor system would remain as a part of the Detroit rather than

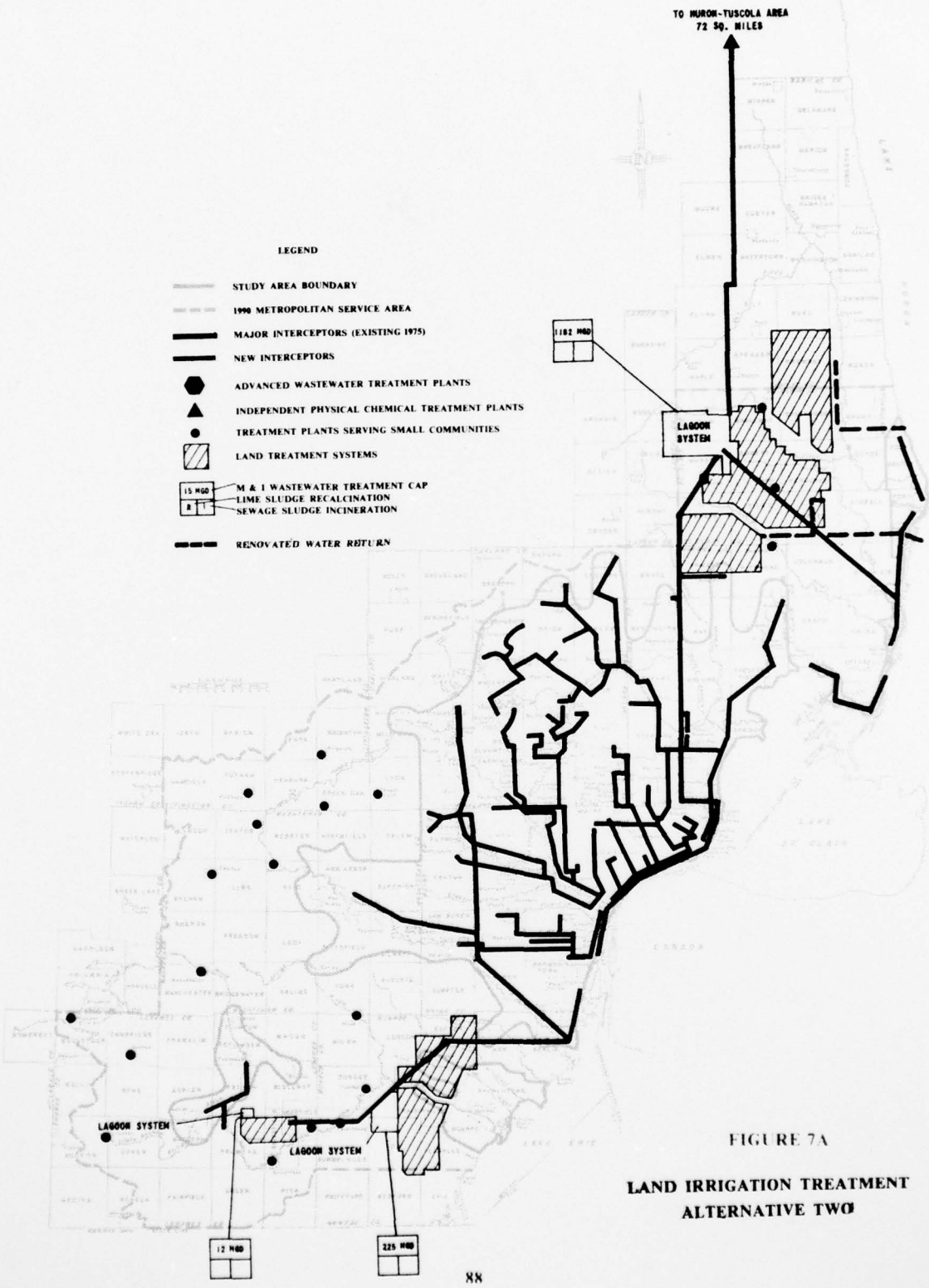


FIGURE 7A

LAND IRRIGATION TREATMENT ALTERNATIVE TWO

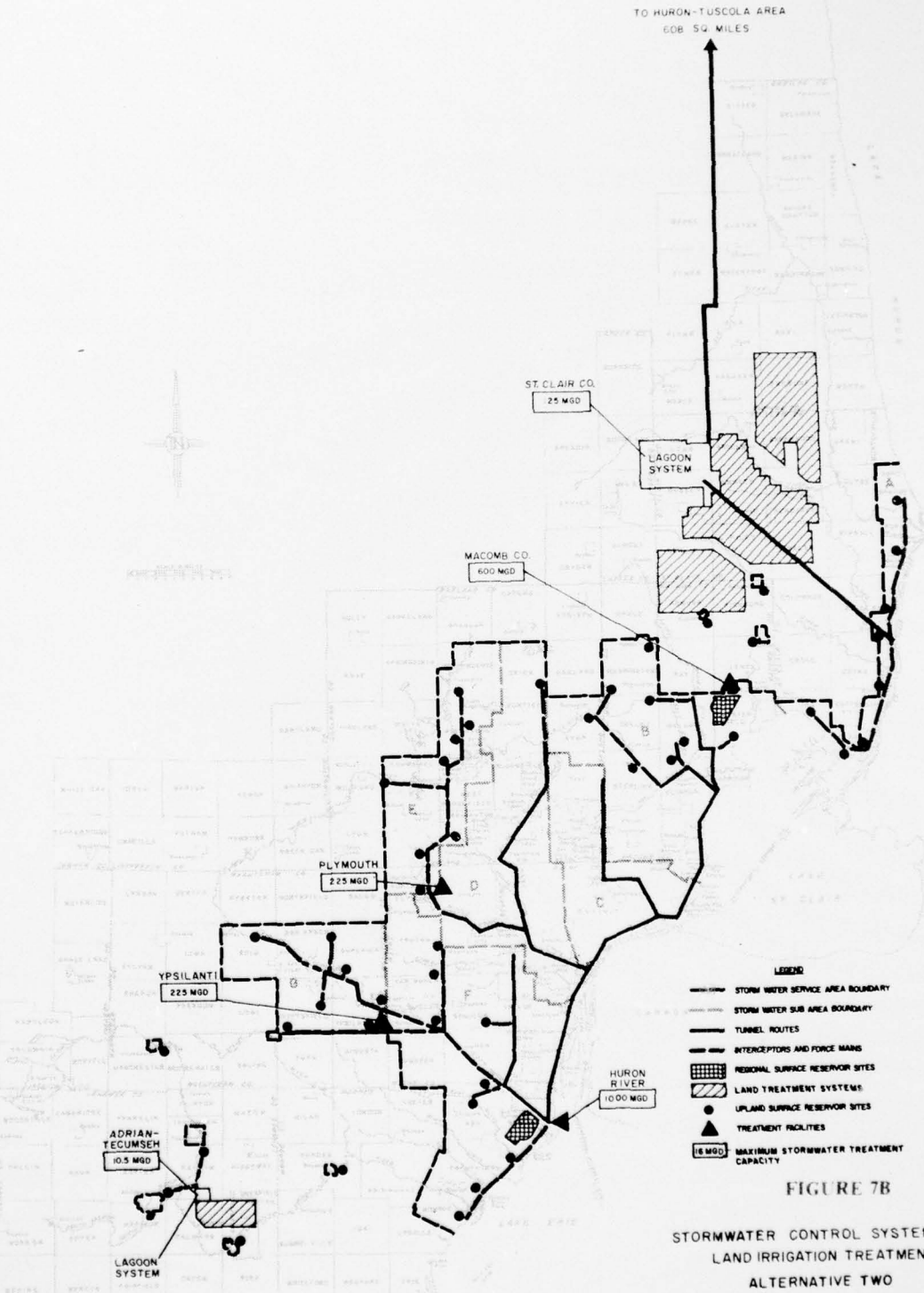


FIGURE 7B

STORMWATER CONTROL SYSTEM FOR
LAND IRRIGATION TREATMENT
ALTERNATIVE TWO

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SOUTHEASTERN MICHIGAN WASTEWATER MANAGEMENT SURVEY SCOPE STUDY.--ETC(U)
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the Huron River system. Other interceptors would be as indicated in earlier alternatives.

The storm runoff in this system would be handled at four major ICPT plants as well as two of the land treatment sites. The four plants would be located at Chesterfield Township in Macomb County, Plymouth, south of Ypsilanti and near the mouth of the Huron River. Stormwater from St. Clair County and the Adrian-Tecumseh areas would be handled on adjacent lagoon and irrigation sites. The collection, storage and transmission system would be the same as employed in the other alternatives.

Sludges generated at the aerated lagoons would be dredged from the settling lagoons and applied to adjacent lands. Solids which would accumulate in stormwater storage lagoons would be removed periodically and disposed of in landfill areas in St. Clair and Lenawee Counties. Sludges generated at stormwater treatment plants would be recalcined and lime reused in the process; the ash would be landfilled with solids from stormwater reservoirs.

System costs and chemical and energy demands are covered in the impact table (Table 11). As in the previous alternative purchase of the irrigation land was assumed to assure operational control of agricultural activities. The total land requirements of the system by type of operation are:

Treatment Plants	550 Acres
Stormwater Storage System	23,500 Acres
Treatment and Storage Lagoons	38,176 Acres
Land Application of Sludge	41,476 Acres
Irrigation	313,128 Acres
Sludge Landfill (50 years)	2,198 Acres

TABLE II
LAND IRRIGATION TREATMENT ALTERNATIVE TWO
IMPACT IDENTIFICATION TABLE

	THE IMMEDIATE VICINITY OF A WASTEWATER FACILITY	THE AREA IN SOUTHEASTERN MICHIGAN SERVED BY THE WASTEWATER SYSTEM	DIRECTLY AFFECTED AREAS OUTSIDE THE SERVICE AREA
I. WATER QUALITY			
A. SURFACE WATERS		Significant improvements could be expected in the water quality in the St. Clair, Clinton, Rouge, Huron, Detroit and Raisin Rivers due to elimination of urban stormwater and wastewater discharges.	
		Peak storm flows would be equalized in the Rouge, Huron and Clinton Rivers due to stormwater storage facilities.	
			An increase in stream baseflow may be experienced in areas under irrigation.
B. GROUND WATER	Some water from irrigated areas may reach ground waters but would only affect quantity not quality.		
	Ground water contamination could result from poorly managed sludge application areas and sludge landfills (primarily nitrates and heavy metals).		
II. AQUATIC LIFE AND WATERFOWL		Habitats for intolerant game fish would be improved; however, artificial stocking would be required to maintain populations.	
III. PUBLIC HEALTH		Pathogen contamination from treatment plant effluents and uncontrolled discharge of urban storm runoff and combined sewer overflow would be virtually eliminated.	
			Infectious disease could be spread by waterfowl or game animals allowed access to stormwater storage lagoons, wastewater treatment and storage lagoons, sludge disposal areas, and wastewater conveyance ditches.
	A potential hazard would exist where large quantities of chlorine would be handled (On site chlorine production would significantly reduce the hazards).		
			Increased concentrations of pathogens could be expected in the air in the vicinity of aerated lagoons and in irrigations areas.
IV. ENERGY AND NATURAL RESOURCES A. AIR		Some gaseous (NO_X and SO_X) and particulate matter would be emmitted from lime sludge recalcination and carbon regeneration operations at stormwater treatment plants.	
	A plume would be visible at stormwater treatment sites from lime sludge recalcination.		
B. CHEMICALS		93,000 tons of chlorine (or raw materials, salt and electrical energy: 2600 kwhr/ton Cl_2) would be consumed annually.	
		153,000 tons of lime (or raw materials, limestone rock and heat energy: 4.25-8.25 million BTU/ton lime) would be consumed annually.	

The comments in this table are intended to identify impacts only; each comment appears under the column identifying the area of greatest significance. *The relative significance for other areas is identified* by the screening indicated in the index to the right.

Equally Significant

Partially Significant

Somewhat Significant

Insignificant

THE REST OF THE STATE OF MICHIGAN	THE LAKE ERIE BASIN	THE NATION	CANADA - INTERNATIONAL
This plan would result in water of higher quality than presently required by the State of Michigan.		This plan meets the intent and time-phased goals of Public Law 92-500.	This plan would comply with the April 1972 agreement with Canada on Great Lakes water quality.
	There is little potential for significant improvement in the western half of Lake Erie with respect to algal blooms and oxygen depletion.		
	If similar wastewater management projects were carried out in the remainder of the Lake Erie basin, ecological recovery may be possible in the eastern half of the lake.		
	Although the habitat for intolerant fishes would be *improved* in Lake Erie, improvement of fisheries will depend on management practices in the commercial fishing industry.		
	Waterfowl populations may improve due to improved habitats and food supplies.		

TABLE II (CONTINUED)
LAND IRRIGATION TREATMENT ALTERNATIVE TWO
IMPACT IDENTIFICATION TABLE

	THE IMMEDIATE VICINITY OF A WASTEWATER FACILITY	THE AREA IN SOUTHEASTERN MICHIGAN SERVED BY THE WASTEWATER SYSTEM	DIRECTLY AFFECTED AREAS OUTSIDE THE SERVICE AREA
			Phosphorus and nitrogen in the irrigated wastewater would be recycled into the environment, reducing the need for commercial fertilizers.
C. ELECTRICAL POWER		The average electrical power demand of 544 megawatts may exceed the planned generating capacity of Detroit Edison (1972 generating capacity: 7,039 mw).	
		The additional 1850 megawatts required for peak stormwater pumping would be met by stand-by generators which could also serve as emergency back-up to the regional power grid.	
D. FUEL OIL OR NATURAL GAS		8 billion BTU of heat energy from fuel oil or natural gas would be required daily.	
V. EMPLOYMENT		Labor demands for construction would cover a period of 10-12 years. The demands for that period would exceed the local supply thus requiring labor from outside the region.	
		Unemployment in the construction trades would be expected to drop with the advent of construction and increase upon completion of the project.	
		Operating manpower for the system, not including the manpower required for farming operations, would be 2083 men.	
			There would be a dramatic shift in employment in the areas to be irrigated and a potentially large rise in unemployment in those areas.
VI. LAND AND WATER USE CHANGES	Land use would be most markedly changed by construction of stormwater storage facilities in and around the urbanized area (23,500 acres) and by construction of treatment and storage lagoons in St. Clair (14,000 acres), Lapeer (14,000 acres), Sanilac (36,000 acres) and Monroe (14,000 acres) Counties.		
		Buffer areas specified for most wastewater facilities have potential use by local units of government for open space or recreational areas.	
		Implementation of this plan would necessitate development of a supplementary water source for the Ann Arbor-Ypsilanti area to avoid abnormally low flows in the Huron River.	
	A potential would exist for developing local industrial water supplies utilizing renovated wastewater particularly in the vicinity of facilities near Adrian, Ypsilanti, Plymouth and the Huron River. Industrial expansion could thus be encouraged in areas previously not industrially oriented.		
	A potential would exist for developing the lagoon systems in St. Clair and Monroe Counties for use as industrial cooling water for power generation or similar operations.		
VII. LAND VALUES		Land values along southeastern Michigan shorelines should increase due to improved water quality over the area and peak flow reduction in the Rouge and Clinton Rivers.	
	Some loss of property value may be experienced in the vicinity of wastewater management facilities due to the stigma associated with such facilities.		
			Although an increase in gross productivity of the irrigated land could be expected, land removed from production for treatment and storage lagoons could result in no net increase in total production.
			Forage type crops to be produced on lands under irrigation would displace any cash crops previously grown.

The comments in this table are intended to identify impacts only; each comment appears under the column identifying the area of greatest significance. The relative significance for other areas is identified by the screening indicated in the index to the right.

Equally Significant

Somewhat Significant

Partially Significant

Insignificant

THE REST OF THE STATE OF MICHIGAN	THE LAKE ERIE BASIN	THE NATION	CANADA - INTERNATIONAL

TABLE II (CONTINUED)
LAND IRRIGATION TREATMENT ALTERNATIVE TWO
IMPACT IDENTIFICATION TABLE

	THE IMMEDIATE VICINITY OF A WASTEWATER FACILITY	THE AREA IN SOUTHEASTERN MICHIGAN SERVED BY THE WASTEWATER SYSTEM	DIRECTLY AFFECTED AREAS OUTSIDE THE SERVICE AREA
VIII. AREA ECONOMY AND INSTITUTIONS		The history of growing intergovernmental cooperation in southeastern Michigan lays the basis *for a regional approach to wastewater management.*	
		Implementation and operation of this alternative would require one of several management organizations having a number of comprehensive management capabilities (i.e. planning, financing, construction, operation, maintenance and administrative capabilities).	
		Implementation of this plan would be contrary to the goals of some communities, particularly Ann Arbor, Pontiac and Warren, which desire to maintain autonomy.	
			419,000 acres of land would be removed from the tax base of local and county governments. The major effects would be felt in St. Clair, Monroe and Huron Counties.
		All existing treatment facilities in the service area would be phased out by 1985.	
		The regional economy would be stimulated temporarily due to demands for construction materials and increased construction payrolls.	
		Gross income in the area would increase due to increased wastewater system payrolls; however, there would be an area-wide decrease in disposable income of each family due to increased sewer charges to offset costs shown under X, below.	
		The creation of an unpolluted water supply would not have a significant effect on existing economic enterprizes, nor is it apt to attract new types of economic activity.	
			Replacement of small farms with large commercial type operations could alter local distribution channels for farm machinery, seed, fertilizer, and crops.
IX. SOCIO-ECONOMICS	Owners of economic establishments and residents *of lands required for construction of wastewater* facilities would have to be relocated.		
	Residents of lands near proposed facilities would have their normal lifestyle disrupted and commercial enterprizes near-by would be affected while construction operations were underway.		
		The system would help satisfy a regional need for expanded water based recreation by providing more waters suitable for total body contact recreation.	
X. SYSTEM COSTS			
A. CAPITAL COSTS		$1,377,000,000	
B. AMORTIZED CAPITAL COST (Average annual)		81,000,000	
C. OPERATION AND MAINTENANCE (Average annual)		115,000,000	
D. TOTAL AVERAGE ANNUAL COST		196,000,000	

The comments in this table are intended to identify impacts only; each comment appears under the column identifying the area of greatest significance. The relative significance for other areas is identified by the screening indicated in the index to the right.

Equally Significant

Somewhat Significant

Partially Significant

Insignificant

THE REST OF THE STATE OF MICHIGAN	THE LAKE ERIE BASIN	THE NATION	CANADA - INTERNATIONAL
		$4,130,000,000 245,000,000 — — 245,000,000	

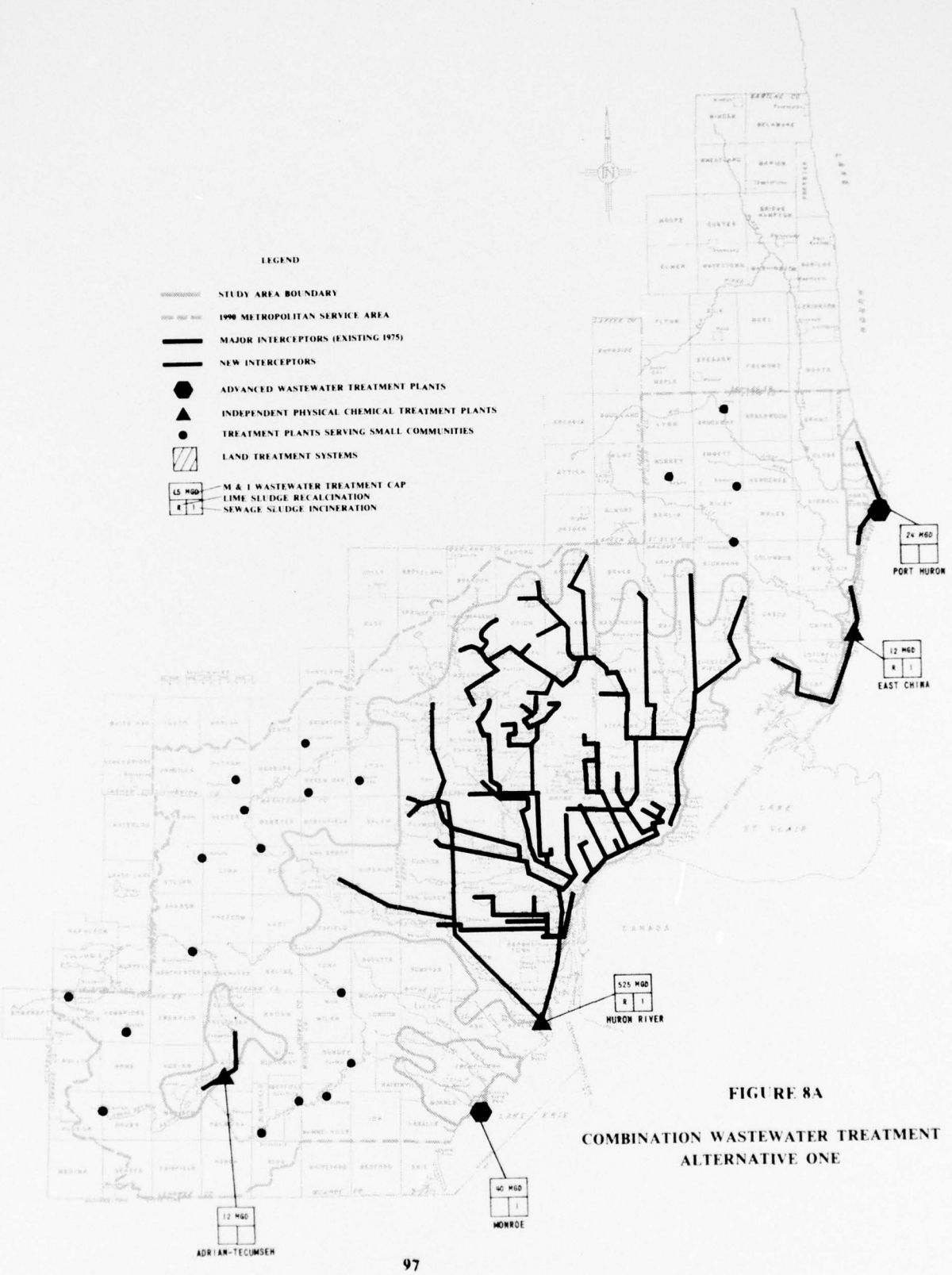

FIGURE 8A

COMBINATION WASTEWATER TREATMENT ALTERNATIVE ONE

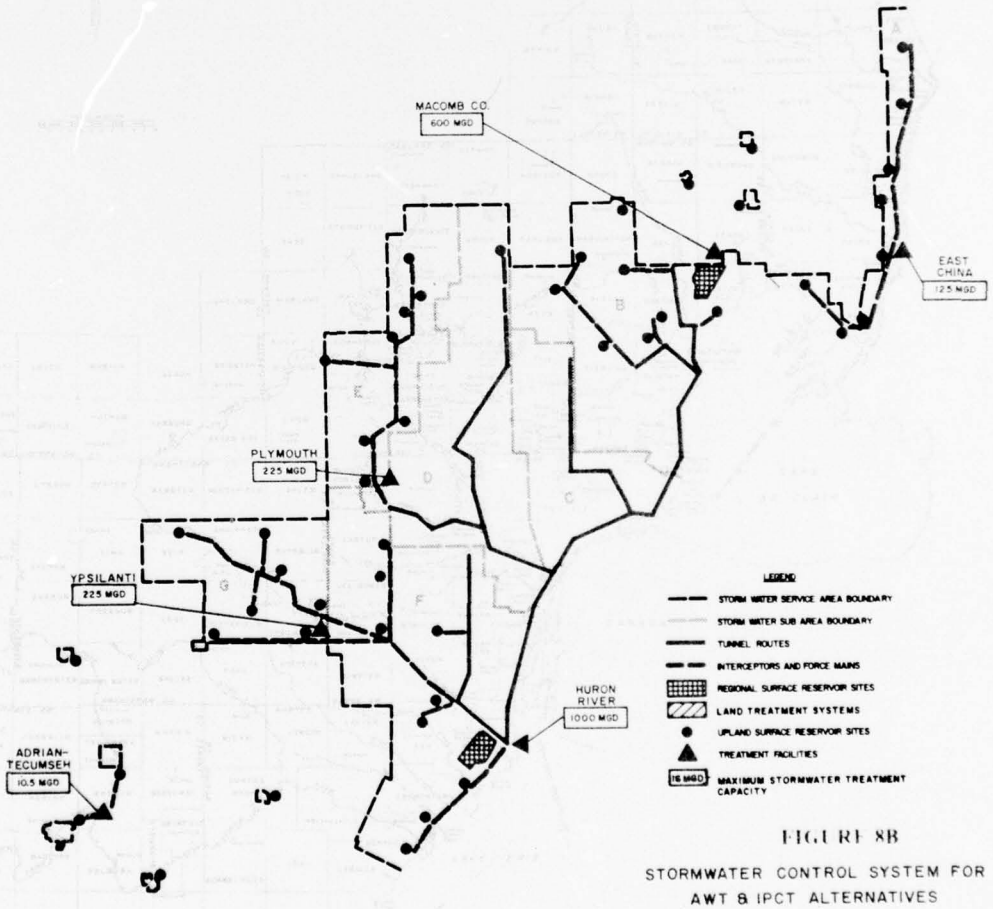

FIGURE 8B

STORMWATER CONTROL SYSTEM FOR AWT & IPCT ALTERNATIVES

Combination Wastewater Treatment Alternative One

This alternative would utilize both advanced wastewater and independent physical-chemical treatment methods for renovation of municipal-industrial wastewater and independent physical-chemical treatment for stormwater. Sewage sludges at AWT plants would be disposed of in the most cost effective manner; and lime and IPCT sludges would be recalcined. Since the AWT process would be used at those existing plants utilized in the system, less chance would exist for disruption of treatment during construction. The IPCT process was selected for all new construction due to its advantages in both cost and energy consumption.

The system would utilize six regional facilities for treatment of municipal-industrial wastewater. Existing plants in Port Huron, Detroit and Monroe would be upgraded to AWT plants; and three new IPCT plants would be constructed at East China, near the mouth of the Huron River and east of Adrian. Additional community advanced treatment plants would be located as shown in figure 8A.

The interceptor system required for implementation of the plan would be the same as required for AWT Alternative One except that the Detroit River interceptor to the Huron River plant would have to be large enough to accommodate the flow from the Wyandotte service area.

The system designed for stormwater would be the same as previously described including a massive system of interceptor sewers and tunnels, storage facilities and treatment at three municipal-industrial wastewater treatment sites (East China, Huron River and Adrian) and three new separate sites (Plymouth, Ypsilanti and Chesterfield Twp.see figure 8B).

Sludge handling methods very from plant to plant. Sewage sludges from the Detroit and Port Huron plants would be filtered and landfilled. Comparable sludges at the Monroe plant would be incinerated and the ash

TABLE 12
COMBINATION WASTEWATER TREATMENT ALTERNATIVE ONE
IMPACT IDENTIFICATION TABLE

	THE IMMEDIATE VICINITY OF A WASTEWATER FACILITY	THE AREA IN SOUTHEASTERN MICHIGAN SERVED BY THE WASTEWATER SYSTEM	DIRECTLY AFFECTED AREAS OUTSIDE THE SERVICE AREA
I. WATER QUALITY			
A. SURFACE WATERS		Significant improvements could be expected in the water quality in the St. Clair, Clinton, Rouge, Huron, Detroit and Raisin Rivers due to elimination of urban stormwater and wastewater discharges.	
		Peak storm flows would be equalized in the Rouge, Huron and Clinton Rivers due to stormwater storage facilities.	
B. GROUND WATER	Ground water contamination could result if sludge landfills in St. Clair and Lenawee Counties were not properly operated (primary contaminants: nitrates & heavy metals).		
II. AQUATIC LIFE AND WATERFOWL		Habitats for intolerant game fish would be improved; however, artificial stocking would be required to maintain populations.	
III. PUBLIC HEALTH		Pathogen contamination from treatment plant effluents and uncontrolled discharge of urban storm runoff and combined sewer overflow would be virtually eliminated.	
		Infectious disease could be spread by waterfowl or other animals allowed access to stormwater storage lagoons or uncovered sludge landfill areas.	
	A potential hazard would exist where large quantities of chlorine would be handled (On site chlorine production would significantly reduce the hazards).		
	Increased concentrations of pathogens could be expected in the air in the vicinity of advanced wastewater treatment plant aeration basins.		
IV. ENERGY AND NATURAL RESOURCES A. AIR		Some gaseous (NO_X and SO_X) and particulate matter would be emmitted from incineration, lime sludge recalcination and carbon regeneration facilities at treatment plant sites.	
	A plume would be visible at incineration and lime sludge recalcination sites due to condensed water vapor.		
B. CHEMICALS		173,000 tons of chlorine (or raw materials, salt and electrical energy: 2600 kwhr/ton Cl_2) would be consumed annually.	
		586,000 tons of lime (or raw materials, limestone rock and heat energy: 4.25-8.25 million BTU/ton lime) would be consumed annually.	
		46,000 tons of methanol (brewery waste could be substituted) would be consumed annually.	
C. ELECTRICAL POWER		The average electrical power demand of 254 megawatts is within the planned capabilities of Detroit Edison.	

The comments in this table are intended to identify impacts only; each comment appears under the column identifying the area of greatest significance. The relative significance for other areas is identified by the screening indicated in the index to the right.

Equally Significant

Somewhat Significant

Partially Significant

Insignificant

THE REST OF THE STATE OF MICHIGAN	THE LAKE ERIE BASIN	THE NATION	CANADA – INTERNATIONAL
This plan would result in water of higher quality than presently required by the State of Michigan.		*This plan meets the intent* and time-phased goals of Public Law 92-500.	This plan would comply with the April 1972 agreement with Canada on Great Lakes water quality.
	There is little potential for significant improvement in the western half of Lake Erie with respect to algal blooms and oxygen depletion.		
	If similar wastewater management projects were *carried out in the remainder of the Lake Erie basin*, ecological recovery may be possible in the eastern half of the lake.		
	Although the habitat for intolerant fishes would be improved in Lake Erie, improvement of fisheries will depend on management practices in the commercial fishing industry.		
	Waterfowl populations may improve due to improved *habitats and food supplies*.		

TABLE 12 (CONTINUED)
COMBINATION WASTEWATER TREATMENT ALTERNATIVE ONE
IMPACT IDENTIFICATION TABLE

	THE IMMEDIATE VICINITY OF A WASTEWATER FACILITY	THE AREA IN SOUTHEASTERN MICHIGAN SERVED BY THE WASTEWATER SYSTEM	DIRECTLY AFFECTED AREAS OUTSIDE THE SERVICE AREA
		The additional 1850 megawatts required for peak stormwater pumping would be met by stand-by generators which could also serve as emergency back-up to the regional power grid.	
D. FUEL OIL OR NATURAL GAS		26 billion BTU of heat energy from fuel oil or natural gas would be required daily.	
V. EMPLOYMENT		Labor demands for construction would cover a period of 10-12 years. The demands for that period would exceed the local supply thus requiring labor from outside the region.	
		Unemployment in the construction trades would be expected to drop with the advent of construction and increase upon completion of the project.	
		The total operating manpower required would be 3131. Special training programs would be necessary to meet demands for technicians and specialty labor categories.	
VI. LAND AND WATER USE CHANGES	Essentially all of the proposed facilities would somewhat alter existing and proposed land use. Expansion of the Port Huron plant would be difficult due to its location in a modern commercial district.		
		Buffer areas specified for most wastewater facilities have potential use by local units of government for open space or recreational areas.	
		Implementation of this plan would necessitate development of a supplementary water source for the Ann Arbor-Ypsilanti area to avoid abnormally low flows in the Huron River.	
	A potential would exist for developing local industrial water supplies utilizing renovated wastewater particularly in the vicinity of facilities near Adrian, Ypsilanti, Plymouth and the Huron River. Industrial expansion could thus be encouraged in areas previously not industrially oriented.		
VII. LAND VALUES		Land values along southeastern Michigan shorelines should increase due to improved water quality over the area and peak flow reduction in the Rouge and Clinton Rivers.	
	Some loss of property value may be experienced in the vicinity of wastewater management facilities due to the stigma associated with such facilities.		
VIII. AREA ECONOMY AND INSTITUTIONS		The history of growing intergovernmental cooperation in southeastern Michigan lays the basis for a regional approach to wastewater management.	
		Implementation and operation of this alternative would require one or several management organizations having a number of comprehensive management capabilities (i.e. planning, financing, construction, operation, maintenance and administrative capabilities).	
		Implementation of this plan would be contrary to the goals of some communities, particularly Ann Arbor, Pontiac and Warren, which desire to maintain autonomy.	
		30,046 acres of land would be removed from the tax base of local and county governments.	
		All existing treatment facilities in the service area with the exception of Detroit, Port Huron and Monroe would be phased out by 1985.	
		The regional economy would be stimulated temporarily due to demands for construction materials and increased construction payrolls.	

The comments in this table are intended to identify impacts only; each comment appears under the column identifying the area of greatest significance. The relative significance for other areas is identified by the screening indicated in the index to the right.

Equally Significant

Somewhat Significant

Partially Significant

Insignificant

THE REST OF THE STATE OF MICHIGAN	THE LAKE ERIE BASIN	THE NATION	CANADA - INTERNATIONAL

TABLE 12 (CONTINUED)
COMBINATION WASTEWATER TREATMENT ALTERNATIVE ONE
IMPACT IDENTIFICATION TABLE

	IN THE IMMEDIATE VICINITY OF A WASTEWATER FACILITY	IN THE AREA IN SOUTHEASTERN MICHIGAN SERVED BY THE WASTEWATER SYSTEM	IN DIRECTLY AFFECTED AREAS OUTSIDE THE SERVICE AREA
		Gross income in the area would increase due to increased wastewater system payrolls; however, there would be an area-wide decrease in disposable income of each family due to increased sewer charges to offset costs shown under X. below.	
		The creation of an unpolluted water supply would not have a significant effect on existing economic enterprises, nor is it apt to attract new types of economic activity.	
IX. SOCIO-ECONOMICS	Owners of economic establishments and residents of lands required for construction of wastewater facilities would have to be relocated.		
	Residents of lands near proposed facilities would have their normal lifestyle disrupted and commercial enterprises near-by would be affected while construction operations were underway.		
		The system would help satisfy a regional need for expanded water based recreation by providing more waters suitable for total body contact recreation.	
X. SYSTEM COSTS			
A. CAPITAL COSTS		$1,044,000,000	
B. AMORTIZED CAPITAL COST (Average annual)		62,000,000	
C. OPERATION AND MAINTENANCE (Average annual)		118,000,000	
D. TOTAL AVERAGE ANNUAL COST		180,000,000	

The comments in this table are intended to identify impacts only; each comment appears under the *column identifying the area of greatest* significance. The relative significance for other areas is identified by the screening indicated in the index to the right.

Equally Significant | Somewhat Significant | Partially Significant | Insignificant

THE REST OF THE STATE OF MICHIGAN	THE LAKE ERIE BASIN	THE NATION	CANADA / INTERNATIONAL
		$3,131,000,000 185,000,000 185,000,000	

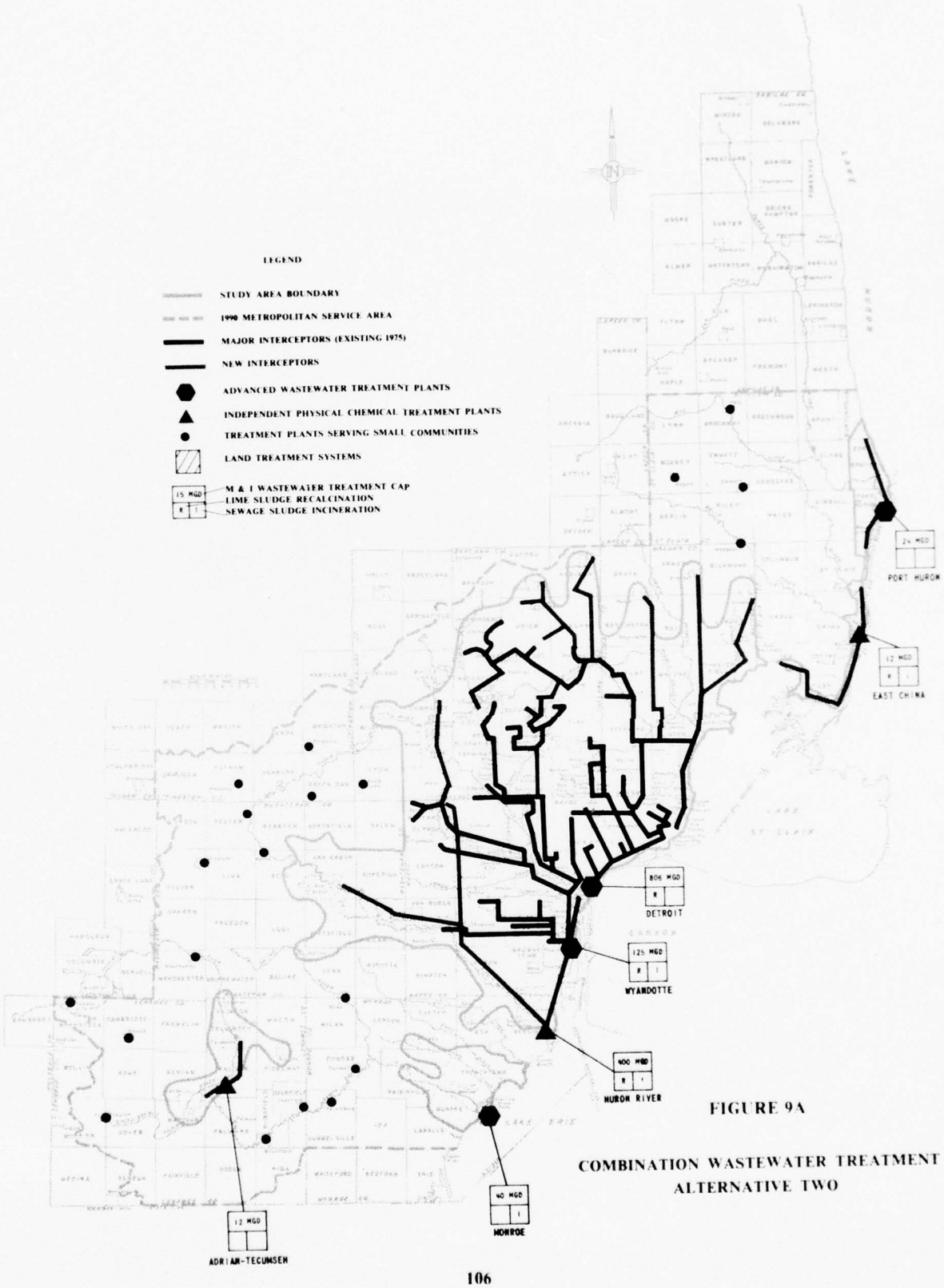

FIGURE 9A

COMBINATION WASTEWATER TREATMENT
ALTERNATIVE TWO

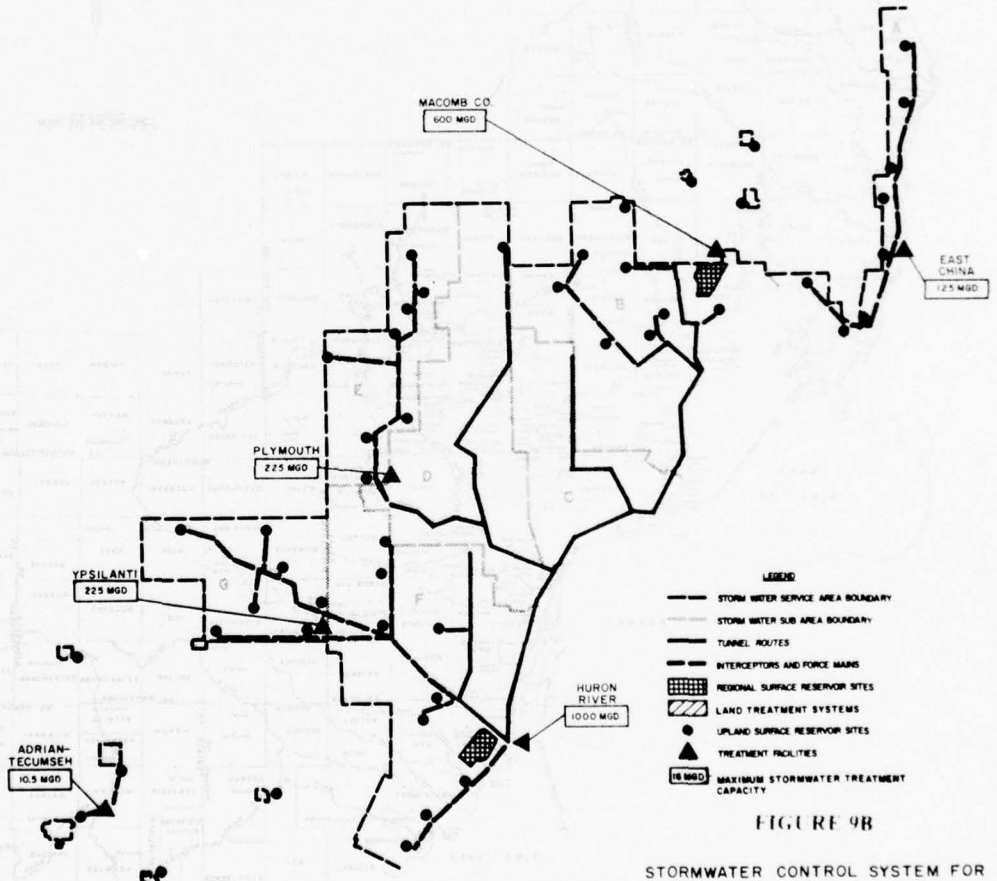

FIGURE 9B

STORMWATER CONTROL SYSTEM FOR AWT & IPCT ALTERNATIVES

landfilled. Lime sludges at Adrian-Tecumseh and Port Huron would be landfilled; and lime sludges from all other plants would be recalcined and the lime reused.

System costs and energy and electrical power demands are covered in the impact table (Table 12). The additional land required for the system by type operation would be:

Treatment Plants	1,212 Acres
Stormwater Collection and Storage	23,500 Acres
Sludge Landfill	5,333 Acres

Combination Wastewater Treatment Alternative Two

This alternative would utilize both advanced wastewater and independent physical-chemical treatment methods for renovation of municipal-industrial wastewater and independent physical-chemical treatment for stormwater. With one exception, this alternative duplicates Combination Alternative One. The exception is that wastewater from the area just south of the Detroit service area would be handled at the Wyandotte plant (upgraded to AWT) rather than being conveyed down river to the Huron River plant (see figure 9A). The purpose of these alternatives is to test the viability of maintaining the Wyandotte plant in a regional scheme.

Major differences between the alternatives would be: (1) location of a plant at Wyandotte employing both sewage sludge incineration and lime sludge recalcination (2) reduced size of the downriver interceptor, and (3) reduced size of the Huron River plant. System costs and energy and chemical demands are covered in the impact table (Table 13). Land requirements for the system by type of operation are:

Treatment plants	1,288 Acres
Stormwater Collection and Storage	5,564 Acres
Sludge Landfill	23,500 Acres

TABLE 13
COMBINATION WASTEWATER TREATMENT ALTERNATIVE TWO
IMPACT IDENTIFICATION TABLE

	THE IMMEDIATE VICINITY OF A WASTEWATER FACILITY	THE AREA IN SOUTHEASTERN MICHIGAN SERVED BY THE WASTEWATER SYSTEM	DIRECTLY AFFECTED AREAS OUTSIDE THE SERVICE AREA
I. WATER QUALITY			
A. SURFACE WATERS		Significant improvements could be expected *in the water quality in the* St. Clair, Clinton, Rouge, Huron, Detroit and Raisin Rivers due to elimination of urban stormwater and *wastewater* discharges.	
		Peak storm flows would be equalized in the Rouge, Huron and Clinton Rivers due to stormwater storage facilities.	
B. GROUNDWATER	*Ground water contamination could result if* sludge landfills in St. Clair and Lenawee Counties were not properly operated (primary contaminants: nitrates & heavy metals).		
II. AQUATIC BIOTA AND WATERFOWL		*Habitats for intolerant game fish would* be improved; however, artificial stocking would be required to maintain populations.	
III. PUBLIC HEALTH		Pathogen contamination from treatment plant effluents and uncontrolled discharge of urban storm runoff and combined sewer overflow would be virtually eliminated.	
		Infectious disease could be spread by waterfowl or other animals allowed access to stormwater storage *lagoons or uncovered* sludge landfill areas.	
	A potential hazard would exist where large quantities of chlorine would be handled (On site chlorine production would significantly reduce the hazards).		
	Increased concentrations of pathogens could be expected in the air in the vicinity of advanced *wastewater treatment plant aeration basins.*		
IV. ENERGY AND NATURAL RESOURCES A. AIR		Some gaseous (NO_X and SO_X) and particulate matter would be emmitted from incineration, lime sludge recalcination and carbon regeneration facilities at treatment plant sites.	
	A plume would be visible at incineration and lime sludge recalcination sites due to condensed water vapor.		
B. CHEMICALS		*151,000 tons of chlorine (or raw materials,* salt and electrical energy: 2600 kwhr/ton (Cl_2) would be consumed annually.	
		573,000 tons of lime (or raw materials, limestone rock and heat energy: 4.25-8.25 million BTU/ton lime) would be consumed annually.	
		52,000 tons of methanol (brewery waste could be *substituted)* would be consumed annually.	
C. ELECTRICAL POWER		The average electrical power demand of 266 megawatts is within the planned capabilities of Detroit Edison.	

The comments in this table are intended to identify impacts only; each comment appears under the column identifying the area of greatest significance. The relative significance for other areas is identified by the screening indicated in the index to the right.

Equally Significant

Somewhat Significant

Partially Significant

Insignificant

THE REST OF THE STATE OF MICHIGAN	THE LAKE ERIE BASIN	THE NATION	CANADA - INTERNATIONAL
This plan would result in water of higher quality than presently required by the State of Michigan.		This plan meets the intent and time-phased goals of Public Law 92-500.	This plan would comply with the April 1 agreement with Canada on Great Lakes water quality.
	There is little potential for significant improvement in the western half of Lake Erie with respect to algal blooms and oxygen depletion.		
	If similar wastewater management projects were carried out in the remainder of the Lake Erie basin, ecological recovery may be possible in the eastern half of the lake.		
	Although the habitat for intolerant fishes would be improved in Lake Erie, improvement of fisheries will depend on management practices in the commercial fishing industry.		
	Waterfowl populations may improve due to improved habitats and food supplies.		

TABLE 13 (CONTINUED)
COMBINATION WASTEWATER TREATMENT ALTERNATIVE TWO
IMPACT IDENTIFICATION TABLE

	THE IMMEDIATE VICINITY OF A WASTEWATER FACILITY	THE AREA IN SOUTHEASTERN MICHIGAN SERVED BY THE WASTEWATER SYSTEM	DIRECTLY AFFECTED AREAS OUTSIDE THE SERVICE AREA
		The additional 1850 megawatts required for peak stormwater pumping would be met by stand-by generators which could also serve as emergency back-up to the regional power grid.	
D. FUEL OIL OR NATURAL GAS		27 billion BTU of heat energy from fuel oil or natural gas would be required daily.	
V. EMPLOYMENT		Labor demands for construction would cover a period of 10-12 years. The demands for that period would exceed the local supply thus requiring labor from outside the region.	
		Unemployment in the construction trades would be expected to drop with the advent of construction and increase upon completion of the project.	
		The total operating manpower required would be 3283. Special training programs would be necessary to meet demands for technicians and specialty labor categories.	
VI. LAND AND WATER USE CHANGES	Essentially all of the proposed facilities would somewhat alter existing and proposed land use. Expansion of the Port Huron plant would be difficult due to its location in a modern commercial district.		
		Buffer areas specified for most wastewater facilities have potential use by local units of government for open space or recreational areas.	
		Implementation of this plan would necessitate development of a supplementary water source for the Ann Arbor-Ypsilanti area to avoid abnormally low flows in the Huron River.	
	A potential would exist for developing local industrial water supplies utilizing renovated wastewater particularly in the vicinity of facilities near Adrian, Ypsilanti, Plymouth and the Huron River. Industrial expansion could thus be encouraged in areas previously not industrially oriented.		
VII. LAND VALUES		Land values along southeastern Michigan shorelines should increase due to improved water quality over the area and peak flow reduction in the Rouge and Clinton Rivers.	
	Some loss of property value may be experienced in the vicinity of wastewater management facilities due to the stigma associated with such facilities.		
VIII. AREA ECONOMY AND INSTITUTIONS		The history of growing intergovernmental cooperation in southeastern Michigan lays the basis for a regional approach to wastewater management.	
		Implementation and operation of this alternative would require one or several management organizations having a number of comprehensive management capabilities (i.e. planning, financing, construction, operation, maintenance and administrative capabilities).	
		Implementation of this plan would be contrary to the goals of some communities, particularly Ann Arbor, Pontiac and Warren, which desire to maintain autonomy.	
		30,353 acres of land would be removed from the tax base of local and county governments.	
		All existing treatment facilities in the service area with the exception of Detroit, Wyandotte, Port Huron and Monroe would be phased out by 1985.	
		The regional economy would be stimulated temporarily due to demands for construction materials and increased construction payrolls.	

The comments in this table are intended to identify impacts only; each comment appears under the column identifying the area of greatest significance. The relative significance for other areas is identified by the screening indicated in the index to the right.

Equally Significant

Somewhat Significant

Partially Significant

Insignificant

THE REST OF THE STATE OF MICHIGAN	THE LAKE ERIE BASIN	THE NATION	CANADA - INTERNATIONAL

TABLE 13 (CONTINUED)
COMBINATION WASTEWATER TREATMENT ALTERNATIVE TWO
IMPACT IDENTIFICATION TABLE

	THE IMMEDIATE VICINITY OF A WASTEWATER FACILITY	THE AREA IN SOUTHEASTERN MICHIGAN SERVED BY THE WASTEWATER SYSTEM	DIRECTLY AFFECTED AREAS OUTSIDE THE SERVICE AREA
		Gross income in the area would increase due to increased wastewater system payrolls; however, there would be an area-wide decrease in disposable income of each family due to increased sewer charges to offset costs shown under X. below.	
		The creation of an unpolluted water supply would not have a significant effect on existing economic enterprizes, nor is it apt to attract new types of economic activity.	
IX. SOCIO-ECONOMICS	Owners of economic establishments and residents of lands required for construction of wastewater facilities would have to be relocated.		
	Residents of lands near proposed facilities would have their normal lifestyle disrupted and commercial enterprizes near-by would be affected while construction operations were underway.		
		The system would help satisfy a regional need for expanded water based recreation by providing more waters suitable for total body contact recreation.	
X. SYSTEM COSTS			
A. CAPITAL COSTS		$1,047,000,000	
B. AMORTIZED CAPITAL COST (Average annual)		62,000,000	
C. OPERATION AND MAINTENANCE (Average annual)		121,000,000	
D. TOTAL AVERAGE ANNUAL COST		183,000,000	

The comments in this table are intended to identify impacts only; each comment appears under the column identifying the area of greatest significance. The relative significance for other areas is identified by the screening indicated in the index to the right.

Equally Significant

Partially Significant

Somewhat Significant

Insignificant

THE REST OF THE STATE OF MICHIGAN	THE LAKE ERIE BASIN	THE NATION	CANADA — INTERNATIONAL
		$3,135,000,000 185,000,000 – – 185,000,000	

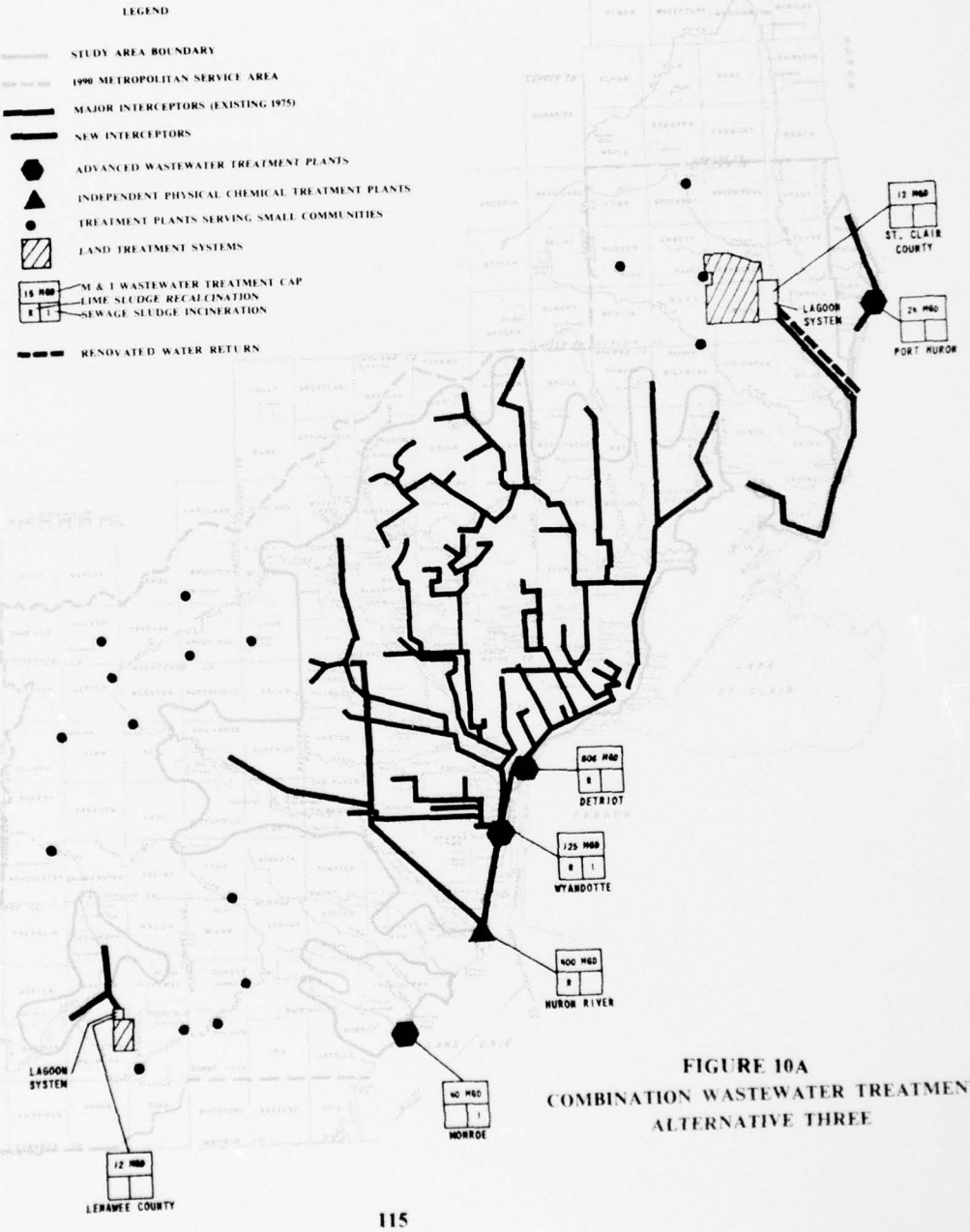

FIGURE 10A
COMBINATION WASTEWATER TREATMENT
ALTERNATIVE THREE

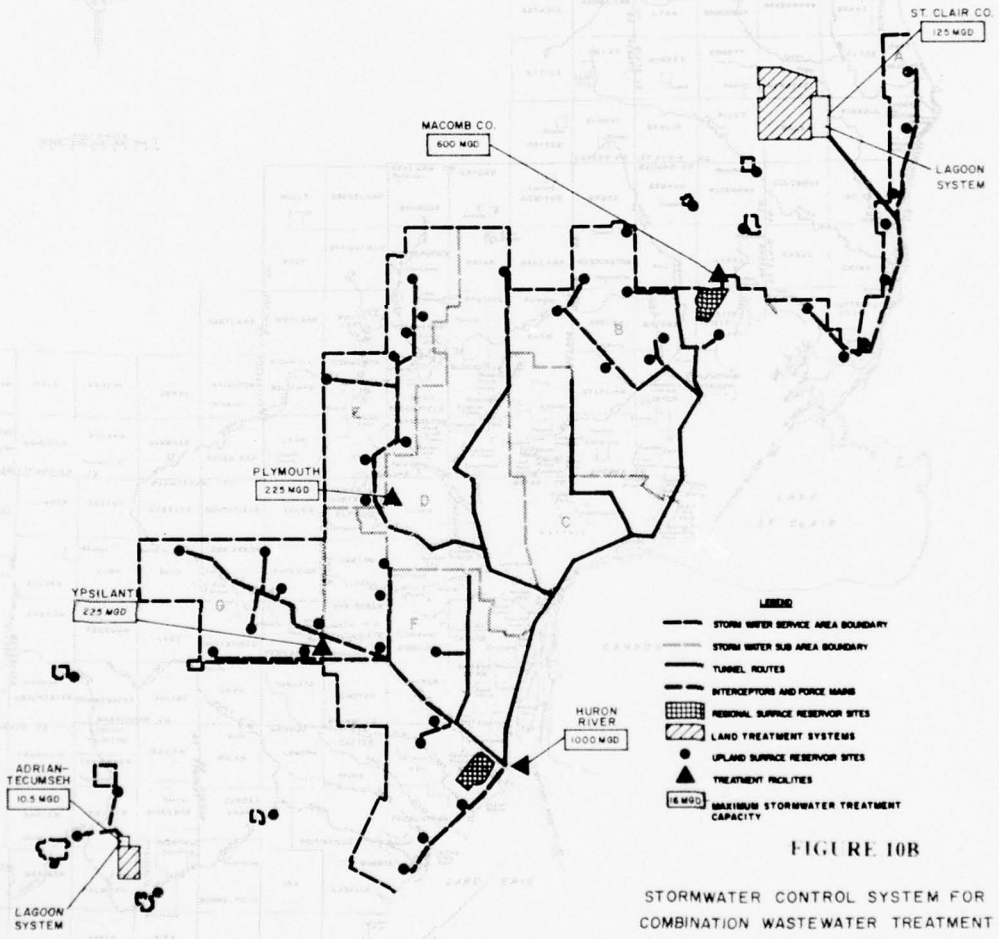

FIGURE 10B

STORMWATER CONTROL SYSTEM FOR COMBINATION WASTEWATER TREATMENT ALTERNATIVE THREE

Combination Wastewater Treatment Alternative Three

This alternative uses advanced wastewater, independent physical-chemical and land irrigation treatment methods for renovation of municipal-industrial wastewater and both independent physical-chemical and land irrigation treatment methods for stormwater renovation. This plan duplicates Combination Alternative Two with the exception that land irrigation treatment would be employed in St. Clair and Lenawee Counties rather than building IPCT plants at East China and Adrian (see figure 10A). This alternative would allow evaluation of land irrigation treatment for less urbanized areas reasonably close to irrigation sites.

Municipal-industrial wastewater would be treated in AWT plants at Port Huron, Detroit, Wyandotte and Monroe, and IPCT plant near the Huron River, and the two irrigation sites referred to earlier. The irrigation system would be a totally controlled system; thus, purchase of the land was assumed necessary. The interceptor system would be as described in earlier alternatives (i.e. AWT Alternative One) except that additional transmission lines would be required from the St. Clair River and Adrian-Tecumseh interceptors to the treatment lagoon sites.

The stormwater collection and storage system would be the same as for other alternatives described previously (see figure 10B). Stormwater treatment would be provided at IPCT plants located in Chesterfield Township in Macomb County, near the mouth of the Huron River, in Plymouth and south of Ypsilanti. Stormwater collected in St. Clair and Lenawee Counties would flow to the land irrigation systems through the same transmission lines as the municipal-industrial wastewater.

Sludge handling at treatment plants would be the same as described in Combination Alternative Two. Sludges removed from the treatment lagoons in the two land irrigation systems would be applied to the land adjacent to the treatment lagoons.

TABLE 14
COMBINATION WASTEWATER TREATMENT ALTERNATIVE THREE
IMPACT IDENTIFICATION TABLE

	THE IMMEDIATE VICINITY OF A WASTEWATER FACILITY	THE AREA IN SOUTHEASTERN MICHIGAN SERVED BY THE WASTEWATER SYSTEM	DIRECTLY AFFECTED AREAS OUTSIDE THE SERVICE AREA
I. WATER QUALITY			
A. SURFACE WATERS		Significant improvements could be expected in the water quality in the St. Clair, Clinton, Rouge, Huron, Detroit and Raisin Rivers due to elimination of urban stormwater and wastewater discharges.	
		Peak storm flows would be equalized in the Rouge, Huron and Clinton Rivers due to stormwater storage facilities.	
			An increase in stream baseflow may be experienced in areas under irrigation.
B. GROUNDWATER	Some water from irrigated areas may reach ground waters but would only affect quantity not quality.		
	Ground water contamination could result from poorly managed sludge application areas and sludge landfills (primarily nitrates and heavy metals).		
II. AQUATIC LIFE AND WATERFOWL		Habitats for intolerant game fish would be improved; however, artificial stocking would be required to maintain populations.	
III. PUBLIC HEALTH		Pathogen contamination from treatment plant effluents and uncontrolled discharge of urban storm runoff and combined sewer overflow would be virtually eliminated.	
			Infectious disease could be spread by waterfowl or game animals allowed access to stormwater storage lagoons, wastewater treatment and storage lagoons, sludge disposal areas, and wastewater conveyance ditches.
	A potential hazard would exist where large quantities of chlorine would be handled (On site chlorine production would significantly reduce the hazards).		
		Increased concentrations of pathogens could be expected in the air in the vicinity of AWT aeration basins, aerated lagoons, and irrigation activities.	
IV. ENERGY AND NATURAL RESOURCES A. AIR		Some gaseous (NO_X and SO_X) and particulate matter would be emmitted from incineration, lime sludge recalcination and carbon regeneration facilities at treatment plant sites.	
	A plume would be visible at incineration and lime sludge recalcination sites due to condensed water vapor.		
B. CHEMICALS		145,000 tons of chlorine (or raw materials, salt and electrical energy: 2600 kwhr/ton Cl_2) would be consumed annually.	
		545,000 tons of lime (or raw materials, limestone rock and heat energy: 4.25-8.25 million BTU/ton lime) would be consumed annually.	

The comments in this table are intended to identify impacts only; each comment appears under the column identifying the area of greatest significance. The relative significance for other areas is identified by the screening indicated in the index to the right.

Equally Significant

Somewhat Significant

Partially Significant

Insignificant

THE REST OF THE STATE OF MICHIGAN	THE LAKE ERIE BASIN	THE NATION	CANADA – INTERNATIONAL
This plan would result in water of higher quality than presently required by the State of Michigan.		This plan meets the intent and time phased goals of Public Law 92-500.	This plan would comply with the April 1972 agreement with Canada on Great Lakes water quality.
	There is little potential for significant improvement in the western half of Lake Erie with respect to algal blooms and oxygen depletion.		
	If similar wastewater management projects were carried out in the remainder of the Lake Erie basin, ecological recovery may be possible in the eastern half of the lake.		
	Although the habitat for intolerant fishes would be improved in Lake Erie, improvement of fisheries will depend on management practices in the commercial fishing industry.		
	Waterfowl populations may improve due to improved habitats and food supplies.		

TABLE 14 (CONTINUED)
COMBINATION WASTEWATER TREATMENT ALTERNATIVE THREE
IMPACT IDENTIFICATION TABLE

	THE IMMEDIATE VICINITY OF A WASTEWATER FACILITY	THE AREA IN SOUTHEASTERN MICHIGAN SERVED BY THE WASTEWATER SYSTEM	DIRECTLY AFFECTED AREAS OUTSIDE THE SERVICE AREA
		46,000 tons of methanol (brewery waste could be substituted) would be consumed annually.	
			Phosphorus and nitrogen in the irrigated wastewater would be recycled into the environment reducing the need for commercial fertilizers.
C. ELECTRICAL POWER		The average electrical power demand of 269 megawatts is within the planned capabilities of Detroit Edison.	
		The additional 1850 megawatts required for peak stormwater pumping would be met by stand-by generators which could also serve as emergency back-up to the regional power grid.	
D. FUEL OIL OR NATURAL GAS		24 billion BTU of heat energy from fuel oil or natural gas would be required daily.	
V. EMPLOYMENT		Labor demands for construction would cover a period of 10-12 years. The demands for that period would exceed the local supply thus requiring labor from outside the region.	
		Unemployment in the construction trades would be expected to drop with the advent of construction and increase upon completion of the project.	
		Operating manpower for the system, not including the manpower required for farming operations, would be 3,227 men.	
VI. LAND AND WATER USE CHANGES	Essentially all of the proposed facilities would somewhat alter existing and proposed land use. Expansion of the Port Huron plant would be difficult due to its location in a modern commercial district.		
		Buffer areas specified for most wastewater facilities have potential use by local units of government for open space or recreational areas.	
		Implementation of this plan would necessitate development of a supplementary water source for the Ann Arbor-Ypsilanti area to avoid abnormally low flows in the Huron River.	
	A potential would exist for developing local industrial water supplies utilizing renovated wastewater particularly in the vicinity of facilities near Adrian, Ypsilanti, Plymouth and the Huron River. Industrial expansion could thus be encouraged in areas previously not industrially oriented.		
VII. LAND VALUES		Land values along southeastern Michigan shorelines should increase due to improved water quality over the area and peak flow reduction in the Rouge and Clinton Rivers.	
	Some loss of property value may be experienced in the vicinity of wastewater management facilities due to the stigma associated with such facilities.		
			Although an increase in gross productivity of the irrigated land could be expected, land removed from production for treatment and storage lagoons could result in no net increase in total production.
			Forage type crops to be produced on lands under irrigation would displace any cash crops previously grown.
VIII. AREA ECONOMY AND INSTITUTIONS		The history of growing intergovernmental cooperation in southeastern Michigan lays the basis for a regional approach to wastewater management.	

The comments in this table are intended to identify impacts only; each comment appears under the column identifying the area of greatest significance. The relative significance for other areas is identified by the screening indicated in the index to the right.

Equally Significant

Somewhat Significant

Partially Significant

Insignificant

THE REST OF THE STATE OF MICHIGAN	THE LAKE ERIE BASIN	THE NATION	CANADA – INTERNATIONAL

TABLE 14 (CONTINUED)
COMBINATION WASTEWATER TREATMENT ALTERNATIVE THREE
IMPACT IDENTIFICATION TABLE

	THE IMMEDIATE VICINITY OF A WASTEWATER FACILITY	THE AREA IN SOUTHEASTERN MICHIGAN SERVED BY THE WASTEWATER SYSTEM	DIRECTLY AFFECTED AREAS OUTSIDE THE SERVICE AREA
		Implementation and operation of this alternative would require one of several management organizations having a number of comprehensive management capabilities (i.e. planning, financing, construction, operation, maintenance and administrative capabilities).	
		Implementation of this plan would be contrary to the goals of some communities, particularly Ann Arbor, Pontiac and Warren, which desire to maintain autonomy.	
		57,250 acres of land would be removed from the tax base of local and county governments.	
		All existing treatment facilities in the service area with the exception of Detroit, Wyandotte, Port Huron and Monroe would be phased out by 1985.	
		The regional economy would be stimulated temporarily due to demands for construction materials and increased construction payrolls.	
		Gross income in the area would increase due to increased wastewater system payrolls; however, there would be an area-wide decrease in disposable income of each family due to increased sewer charges to offset costs shown under X. below.	
		The creation of an unpolluted water supply would not have a significant effect on existing economic enterprizes, nor is it apt to attract new types of economic activity.	
			Replacement of small farms with large commercial type operations could alter local distribution channels for farm machinery, seed, fertilizer and crops.
IX. SOCIO-ECONOMICS	Owners of economic establishments and residents of lands required for construction of wastewater facilities would have to be relocated.		
	Residents of lands near proposed facilities would have their normal lifestyle disrupted and commercial enterprizes near-by would be affected while construction operations were underway.		
		The system would help satisfy a regional need for expanded water based recreation by providing more waters suitable for total body contact recreation.	
X. SYSTEM COSTS			
A. CAPITAL COSTS		$1,065,000,000	
B. AMORTIZED CAPITAL COST (Average annual)		63,000,000	
C. OPERATION AND MAINTENANCE (Average annual)		122,000,000	
D. TOTAL AVERAGE ANNUAL COST		185,000,000	

The comments in this table are intended to identify impacts only; each comment appears under the column identifying the area of greatest significance. The relative significance for other areas is identified by the screening indicated in the index to the right.

Equally Significant

Somewhat Significant

Partially Significant

Insignificant

THE REST OF THE STATE OF MICHIGAN	THE LAKE ERIE BASIN	THE NATION	CANADA — INTERNATIONAL
		$U,197,000,000 189,000,000 -- 189,000,000	

Estimates of system costs and the energy and chemical demands of the system appear in the impact table (Table 14). The land required for the system by type of operation would be:

Treatment Plants	1,188 Acres
Stormwater Storage System	23,500 Acres
Treatment and Storage Lagoons	2,691 Acres
Land Application of Sludge	700 Acres
Irrigation	23,740 Acres
Sludge Landfill (50 years)	5,432 Acres

Combination Wastewater Treatment Alternative Four

This alternative, like the previous alternative, would use advanced wastewater, and land irrigation treatment methods for municipal-industrial wastewater renovation and both independent physical-chemical and land irrigation treatment methods for stormwater treatment. In this plan, land irrigation treatment would be utilized in lieu of building any new regional plants for treatment of municipal-industrial wastewater.

Municipal-industrial wastewater treatment plants in Port Huron, Detroit, Wyandotte and Monroe would be maintained and upgraded with AWT processes. The remainder of the wastewater would be handled at land systems located in St. Clair, Monroe and Lenawee Counties (see figure 11A).

Some changes in the regional interceptor system would be required. Wastewater would arrive at the St. Clair County lagoon system through a transmission line from the St. Clair area with wastewater from southern St. Clair County and a transmission line which would intercept the flow from the Oakland-Macomb interceptor system. Flow from the north half of the Hanna Road interceptor would flow into the Detroit interceptor system. The wastewater from the Huron River interceptor and the downriver Detroit

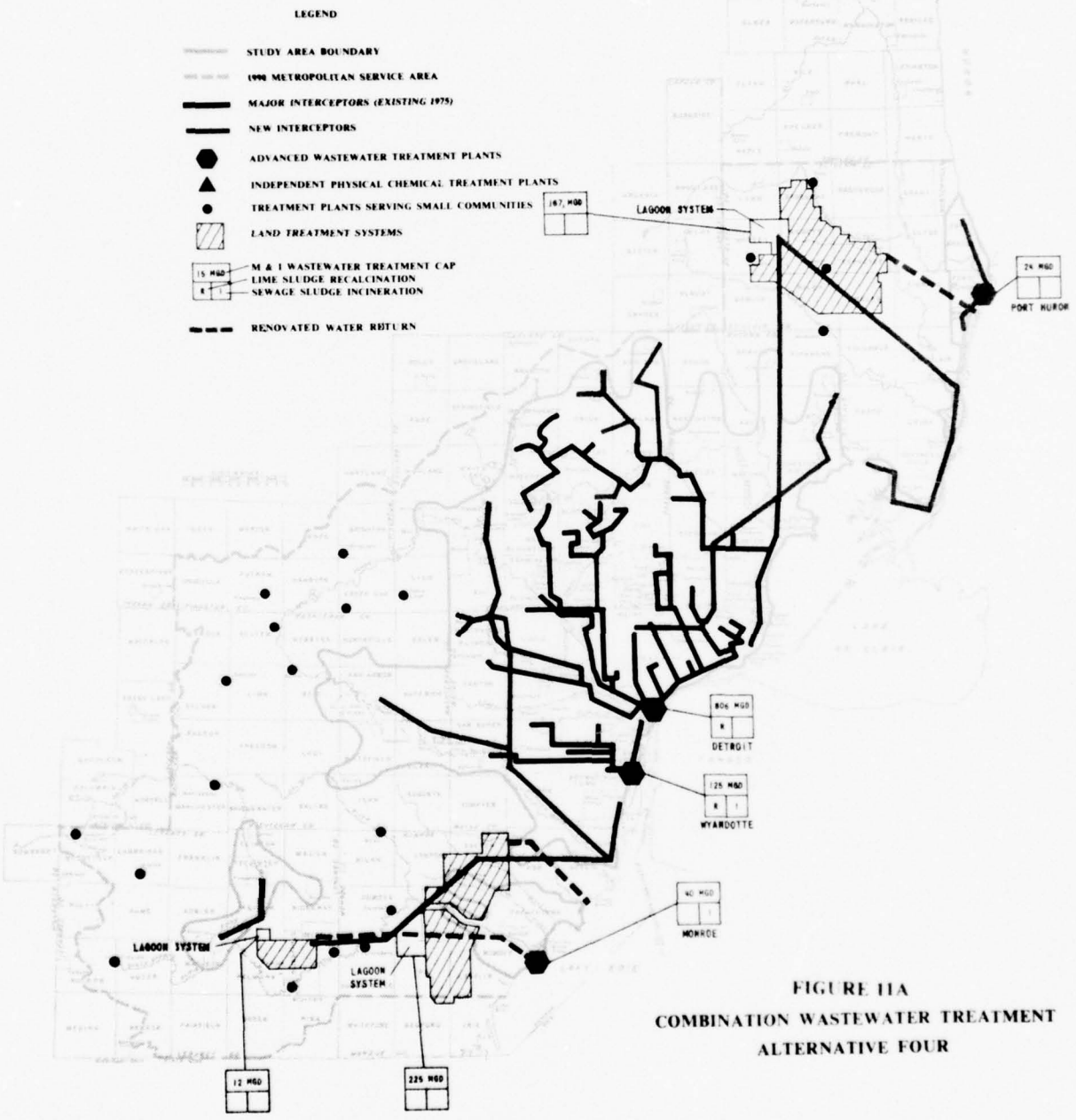

FIGURE 11A
COMBINATION WASTEWATER TREATMENT
ALTERNATIVE FOUR

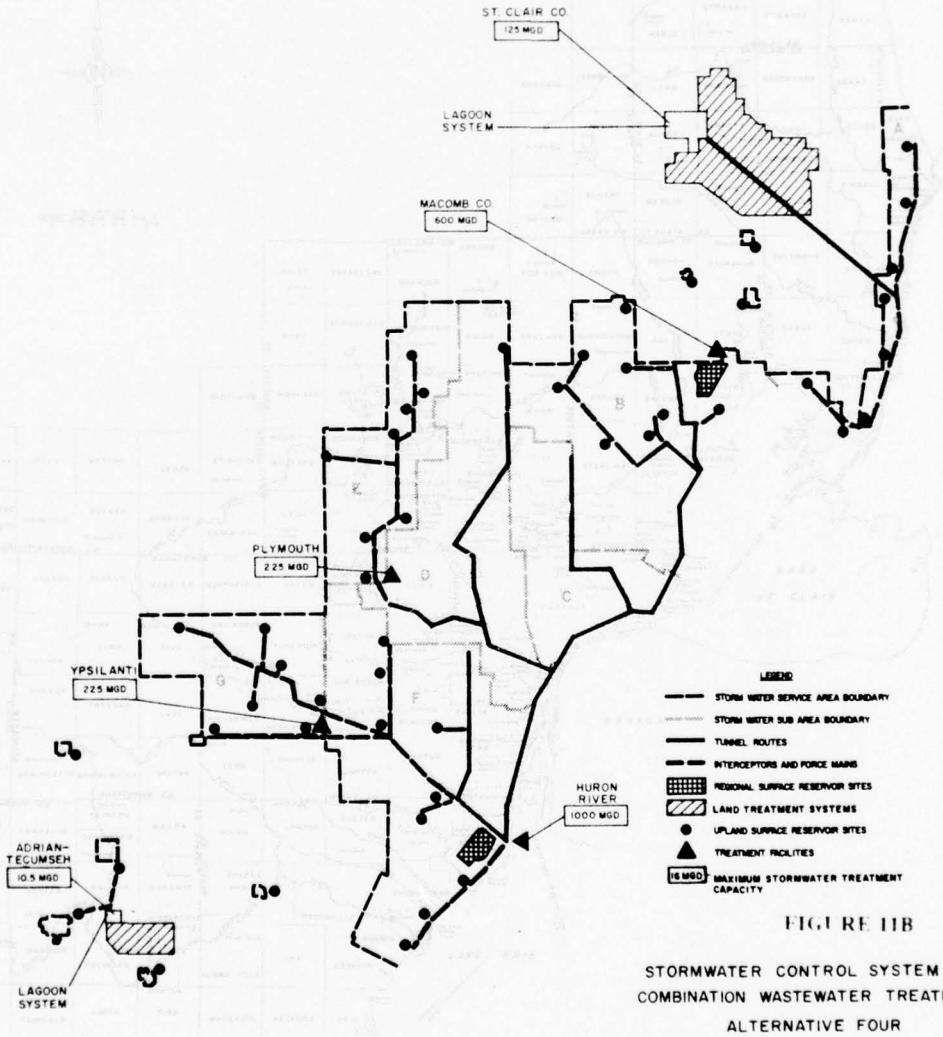

FIGURE IIB

STORMWATER CONTROL SYSTEM FOR COMBINATION WASTEWATER TREATMENT ALTERNATIVE FOUR

interceptors would flow to the Monroe County lagoon system for subsequent irrigation on land in Monroe and Lenawee Counties.

The stormwater would be handled in the same manner as described in Combination Alternative Three (see figure 11B). Stormwater plants would be located in Chesterfield Township, near the Huron River, in Plymouth, and south of Ypsilanti. The stormwater collected in St. Clair and Lanawee Counties would be handled in nearby land irrigation system.

Sludges generated in the lagoon treatment sites would be applied to land adjacent to the lagoons. Sewage sludges would be incinerated at the Wyandotte and Monroe sites; and lime sludges would be recalcined at all but the Monroe and Port Huron plants. The remainder of the sludges and the stormwater solids would be disposed of at landfill sites in St. Clair and Lenawee Counties.

Estimates of costs and energy and chemical demands for this plan appear in the impact table (Table 15). The land requirements for implementing the system would be:

Treatment Plants	1,058 Acres
Stormwater Storage System	23,500 Acres
Treatment and Storage Lagoons	11,501 Acres
Land Application of Sludge	13,490 Acres
Irrigation	108,171 Acres
Sludge Landfill (50 years)	4,899 Acres

TABLE 15
COMBINATION WASTEWATER TREATMENT ALTERNATIVE FOUR
IMPACT IDENTIFICATION TABLE

	THE IMMEDIATE VICINITY OF A WASTEWATER FACILITY	THE AREA IN SOUTHEASTERN MICHIGAN SERVED BY THE WASTEWATER SYSTEM	DIRECTLY AFFECTED AREAS OUTSIDE THE SERVICE AREA
I. WATER QUALITY			
A. SURFACE WATERS		Significant improvements could be expected in the water quality in the St. Clair, Clinton, Rouge, Huron, Detroit and Raisin Rivers due to elimination of urban stormwater and wastewater discharges.	
		Peak storm flows would be equalized in the Rouge, Huron and Clinton Rivers due to stormwater storage facilities.	
			An increase in stream baseflow may be experienced in areas under irrigation.
B. GROUND WATER	Some water from irrigated areas may reach ground waters but would only affect quantity not quality.		
	Ground water contamination could result from poorly managed sludge application areas and sludge landfills (primarily nitrates and heavy metals).		
II. AQUATIC LIFE AND WATERFOWL		Habitats for intolerant game fish would be improved; however, artificial stocking would be required to maintain populations.	
III. PUBLIC HEALTH		Pathogen contamination from treatment plant effluents and uncontrolled discharge of urban storm runoff and combined sewer overflow would be virtually eliminated.	
			Infectious disease could be spread by waterfowl or game animals allowed access to stormwater storage lagoons, wastewater treatment and storage lagoons, sludge disposal areas, and wastewater conveyance ditches.
	A potential hazard would exist where large quantities of chlorine would be handled (On site chlorine production would significantly reduce the hazards).		
		Increased concentrations of pathogens could be expected in the air in the vicinity of AWT aeration basins, aerated lagoons, and irrigation activities.	
IV. ENERGY AND NATURAL RESOURCES A. AIR		Some gaseous (NO_X and SO_X) and particulate matter would be emmitted from incineration, lime sludge recalcination and carbon regeneration facilities at treatment plant sites.	
	A plume would be visible at incineration and lime sludge recalcination sites due to condensed water vapor.		
B. CHEMICALS		79,000 tons of chlorine (or raw materials, salt and electrical energy: 2600 kwhr/ton Cl_2) would be consumed annually.	
		441,000 tons of lime (or raw materials, limestone rock and heat energy: 4.25-8.25 million BTU/ton lime) would be consumed annually.	

The comments in this table are intended to identify impacts only; each comment appears under the column identifying the area of greatest significance. The relative significance for other areas is identified by the screening indicated in the index to the right.

Equally Significant

Somewhat Significant

Partially Significant

Insignificant

THE REST OF THE STATE OF MICHIGAN	THE LAKE ERIE BASIN	THE NATION	CANADA
This plan would result in water of higher quality than presently required by the State of Michigan.		This plan meets the intent and time-phased goals of Public Law 92-500.	This plan would [illegible] with the [illegible] agreement with Canada on Great Lakes water quality.
	There is little potential for significant improvement in the western half of Lake Erie with respect to algal blooms and oxygen depletion.		
	If similar wastewater management projects were carried out in the remainder of the Lake Erie basin, ecological recovery may be possible in the eastern half of the lake.		
	Although the habitat for intollerant fishes would be improved in Lake Erie, improvement of fisheries will depend on management practices in the commercial fishing industry.		
	Waterfowl populations may improve due to improved habitats and food supplies.		

TABLE 15 (CONTINUED)
COMBINATION WASTEWATER TREATMENT ALTERNATIVE FOUR
IMPACT IDENTIFICATION TABLE

	IN THE IMMEDIATE VICINITY OF A WASTEWATER FACILITY	IN THE AREA IN SOUTHEASTERN MICHIGAN SERVED BY THE WASTEWATER SYSTEM	DIRECTLY AFFECTED AREAS OUTSIDE THE SERVICE AREA
		52,000 tons of methanol (brewery waste could be substituted) would be consumed annually.	
			Phosphorus and nitrogen in the irrigated wastewater would be recycled into the environment reducing the need for commercial fertilizers.
C. ELECTRICAL POWER		The average electrical power demand of 351 megawatts should not exceed the planned generating capacity of *Detroit Edison.*	
		The additional 1850 megawatts required for peak stormwater pumping would be met by stand-by generators which could also serve as emergency back-up to the regional power grid.	
D. FUEL OIL OR NATURAL GAS		20 billion BTU of heat energy from fuel oil or natural gas would be required daily.	
E. EMPLOYMENT		Labor demands for construction would cover a period of 10-12 years. The demands for that period would exceed the local supply thus requiring labor from outside the region.	
		Unemployment in the construction trades would be expected to drop with the advent of construction and increase upon completion of the project.	
		Operating manpower for the system, not including the manpower required for farming operations, would be 3198 men.	
VI. LAND AND WATER USE CHANGES	Essentially all of the proposed facilities would somewhat alter existing and proposed land use. Expansion of the Port Huron plant would be difficult due to its location in a modern commercial district.		
		Buffer areas specified for most wastewater facilities have potential use by local units of government for open space or recreational areas.	
		Implementation of this plan would necessitate development of a supplementary water source for the Ann Arbor-Ypsilanti area to avoid abnormally low flows in the Huron River.	
	A potential would exist for developing local industrial water supplies utilizing renovated wastewater particularly in the vicinity of facilities near Adrian, Ypsilanti, Plymouth and the Huron River. Industrial expansion could thus be encouraged in areas previously not industrially oriented.		
	A potential would exist for developing the lagoon systems in St. Clair and Monroe Counties for use as industrial cooling water for power generation or similar operations.		
VII. LAND VALUES		Land values along southeastern Michigan shorelines should increase due to improved water quality over the area and peak flow reduction in the Rouge and Clinton Rivers.	
	Some loss of property value may be experienced in the vicinity of wastewater management facilities due to the stigma associated with such facilities.		
			Although an increase in gross productivity of the irrigated land could be expected; land removed from production for treatment and storage lagoons could result in no net increase in total production.
			Forage type crops to be produced on lands under irrigation would displace any cash crops previously grown.
VIII. AREA ECONOMY AND INSTITUTIONS		The history of growing intergovernmental cooperation in southeastern Michigan lays the basis for a regional approach to wastewater management.	

The comments in this table are intended to identify impacts only; each comment appears under the column identifying the area of greatest significance. The relative significance for other areas is identified by the screening indicated in the index to the right.

Equally Significant

Partially Significant

Somewhat Significant

Insignificant

THE REST OF THE STATE OF MICHIGAN	THE LAKE ERIE BASIN	THE NATION	CANADA - INTERNATIONAL

TABLE 15 (CONTINUED)
COMBINATION WASTEWATER TREATMENT ALTERNATIVE FOUR
IMPACT IDENTIFICATION TABLE

	THE IMMEDIATE VICINITY OF A WASTEWATER FACILITY	THE AREA IN SOUTHEASTERN MICHIGAN SERVED BY THE WASTEWATER SYSTEM	DIRECTLY AFFECTED AREAS OUTSIDE THE SERVICE AREA
		Implementation and operation of this alternative would require one or several management organizations having a number of comprehensive management capabilities (i.e. planning, financing, *construction, operation, maintenance* and administrative capabilities).	
		Implementation of this plan would be contrary to the goals of some communities, particularly Ann Arbor, Pontiac and Warren, which desire to maintain autonomy.	
			162,620 acres of land would be removed from the tax base of local and county governments. The major effects would be felt in St. Clair and Monroe Counties.
		All existing treatment facilities in the service area with the exception of Detroit, Wyandotte, Port Huron and Monroe would be phased out by 1985.	
		The regional economy would be stimulated temporarily due to demands for construction *materials and increased* construction payrolls.	
		Gross income in the area would increase due to increased wastewater system payrolls; however, there would be an area-wide decrease in disposable income of each family due to increased sewer charges to offset costs shown under V. below.	
		The creation of an unpolluted water supply would not have a significant effect on existing economic enterprizes, nor is it apt to attract new types of economic activity.	
			Replacement of small farms with large commercial type operations could alter local distribution channels for farm machinery, seed, fertilizer and crops.
IV. SOCIO-ECONOMICS	Owners of economic establishments and residents of lands required for construction of wastewater facilities would have to be relocated.		
	Residents of lands near proposed facilities would have their normal lifestyle disrupted and commercial enterprizes near-by would be affected while construction operations were underway.		
		The system would help satisfy a regional need for expanded water based recreation by providing more waters suitable for total body contact recreation.	
V. SYSTEM COSTS			
A. CAPITAL COSTS		$1,142,000,000	
B. AMORTIZED CAPITAL COST (Average annual)		67,000,000	
C. OPERATION AND MAINTENANCE (Average annual)		113,000,000	
D. TOTAL AVERAGE ANNUAL COST		180,000,000	

THE REST OF THE STATE OF MICHIGAN	THE LAKE ERIE BASIN	THE NATION	CANADA - INTERNATIONAL
		$3,426,000,000 203,000,000 - - 203,000,000	

Chapter VII

EVALUATION OF PRELIMINARY ALTERNATIVES

A review of the impact tables presented with each of the preliminary alternatives reveals that many of the statements are common for a number if not all alternatives. The tables were intended only to identify impacts and not to attach any measure of relative degree of impact. In the discussion that follows, the preliminary alternatives will be compared in the different evaluation categories.

Water Quality

With the exception of the Interim Water Quality Plan, all of the alternatives were designed to approach the 1985 "no discharge of pollutants" goal of Public Law 92-500. For each of these plans, a significant improvement in water quality could be expected downriver of the southeastern Michigan area. Rivers and streams within the southeastern Michigan area would also be greatly improved due to the high level of treatment provided by inland plants and by the collection and treatment of urban storm runoff and combined sewer overflow. The only way in which the alternatives would differ in their effects on surface waters would be in the location of the treated water discharges. Those effects should only be realized in quantity of water rather than quality.

The Interim Water Quality Plan was designed to a somewhat lower level and thus would not be as effective in improving surface water quality. The primary difference between the Interim Plan and the other preliminary alternatives, with respect to surface water quality, would be that the Interim Plan would not address urban storm runoff as a source of surface water pollution.

A primary conclusion drawn from baseline studies conducted by the Institute of Water Research at Michigan State University was that ". . . even 100% elimination of municipal and industrial wastes from Southeastern Michigan coupled with clean-up of Michigan's tributary streams would not be adequate in significantly improving conditions in Lake Erie . . . for any major improvements of water quality to be realized in Lake Erie it is essential to reduce inputs from all watersheds bordering the Lake; not just Michigan's." The conclusions drawn were based on suggestions that "the single most outstanding treatment need for Lake Erie after disease threats are eradicated" was phosphorus removal. Assessment of abilities of the plans to improve water quality in Lake Erie were based on an assumption that similar plans would be implemented throughout the western basin and that proper land management and wastewater treatment would be employed to reduce phosphorus in tributary streams throughout the western basin.

Although the Interim Plan may have some effect on improving water quality in the Lake, algae related problems would not be affected and improvement to the Lake may not be obvious. If any of the preliminary alternatives were implemented, algae related problems in the eastern half of the Lake should be reduced. Improvement of the western half of the Lake would only be realized over a period of many years if at all. Of the preliminary alternatives, Land Irrigation Treatment Alternative One was identified as having the greatest potential for improving conditions in the Lake. That was due to the fact that land irrigation treatment claims a greater ability to remove phosphorus than the other treatment facilities as designed.

Ground water contamination is another area of concern especially when considering land irrigation treatment, land application of sludge and landfill of sludge. In general, any of the three operations, if properly designed, operated and maintained should have no effect on ground water quality, although quantity could be increased through irrigation. Ground water contamination could occur, however, if high standards are not maintained. Areas which are under irrigation or used for sludge application

could release adsorbed heavy metals if aerobic conditions are not maintained in the soil. Aerobic conditions are most likely to be disturbed if wastewater or sludge application rates are too high for extended periods. Excess sludge application could also result in excessive nitrogen leaching into ground water tables.

Ground water contamination from sludge landfill areas could best be avoided by incineration sludges prior to landfilling. Contamination from leachate from the fill can be avoided by properly lining the fill itself and by employing proper drainage to keep area runoff from draining to the fill site.

Aquatic Life and Waterfowl

The effects any of these alternatives would have on aquatic life habitats can be directly related to the degree of improvement in water quality. A primary problem to aquatic life in Lake Erie and inland streams is the maintenance of sufficient oxygen levels. Low oxygen levels result from both the oxygen demanding substances in waste discharges and from excessive plant growth resulting from an abundance of nutrients (phosphorus and nitrogen) in wastewater. In the various alternatives, stream quality and thus aquatic habitats would be improved by increased levels of wastewater collection and treatment and by diversion of treated discharges to points further downstream. Storm runoff has been a serious problem in southeastern Michigan rivers and in the bays near the river mouths.

Many factors have led to the great change in fish populations in Lake Erie and inland streams; and elimination of all urban waste discharges would not be sufficient for the system to recover to its previous condition. Artificial stocking will continue to be necessary to maintain game fish populations. The evaluators concluded that "Changes in the fish population are probably much more dependent now on the management of fisheries in Lake Erie than on some reversal of eutrophication."

Improved water quality and aquatic life habitats would also have positive effects on waterfowl. Although the marsh lands bordering Lake Erie, Lower Detroit River, and Lake St. Clair have been reduced to a fraction of their former size; and habitat deterioration from various forms of pollution has occurred; significant numbers of waterfowl use the area. Imporved wastewater management programs would be beneficial to waterfowl by controlling toxic substances such as oils, heavy metals, and biocides that may cause direct mortality, and by maintaining the plant and animal communities that serve as food.

Public Health

The most significant impact which would be created by implementation of any of the alternatives would be the virtual elimination of pathogens from urban wastewater sources. At the present time, that wastewater which is collected and treated is only partially disinfected prior to disposal. Further, approximately 50 percent of the service area is sewered for combined sanitary and storm runoff wastewater. Overflows of the combined systems are frequent and result in direct discharge of raw wastewater to surface rivers and streams. All alternatives, including the Interim Plan, address this problem; although the interim plan would not be quite as effective as the other alternatives.

A major concern of the critics of land irrigation and land disposal of sludge is the contamination of ground water with pathogens as well as harmful chemical material. The problem of harmful chemicals was discussed previously; however, it should be noted that nitrate contamination of ground water is the most important concern. The soil mantle, under proper soil conditions, can be expected to efficiently remove most microbial pathogens. If soil alkvlinity is controlled, the soil mantle can also be expected to adsorb most viral pathogens.

The evaluators did point out other areas of concern which would

require further data before the degree of the problem, if any, could be established:

(1) Pathogens from aeration basins in both AWT plants and lagoon treatment systems could be spread considerable distances to infect individuals. Although aeration is used extensively in wastewater treatment, no incidence of disease has been attributed to that source.

(2) Areas which receive intermittent spray irrigation, if permitted to dry, could make wind transmission of potentially dangerous fungal spores a real problem. Many of the fungal diseases which have an unknown natural habitat could find an environment of this nature very suitable for propagation.

(3) Some diseases such as tuberculosis could be spread by livestock which would feed on grasses irrigated with incompletely disinfected wastewater or non-stabilized sewage sludge.

Another critical area of concern would be the handling and storage of large quantities of chlorine. Treatment facilities, especially the independent physical-chemical facilities, require great quantities of this lethal chemical. The best solution to the problem would be the direct manufacture of chlorine on the plant site. The process would be economically feasible, would eliminate the need to haul chlorine through urban areas and would restrict the hazards to a smaller more controllable environment.

Energy and Natural Resources

In earlier discussions of sludge handling, consideration of air emissions from incineration and lime sludge recalcination was discussed. Particulate matter from the combustion processes can be controlled to high degrees of efficiency. The most critical gaseous constituents, nitrogen and sulfur oxides, would, with present technology, be uncontrollable in

the stack. Nitrogen oxide formation could be reduced by properly controlling combustion temperatures and excess air in the combustion chamber. The evaluation team from the University of Michigan School of Public Health supports incineration as the most hygienically desirable alternative. Due to the high water content of sludges, a white plume would be unavoidable above the stack.

Chemical requirements for the alternatives are summarized in Table 16. For the chemicals required, the primary demand for resources would be for the energy consumed in manufacturing the chemical. Lime is made by heating limestone rock; most chlorine is made by an electrical process using common salt and methanol can be made by a variety of processes which consume energy in processing and high energy materials such as hydrogen or natural gas as a raw material.

The energy requirements for each alternative are also listed in Table 16. Energy is broken into categories of both electrical energy and heat energy from fossil fuel sources (oil, coal or natural gas). In the final column, a figure is given for equivalent energy. This is a composite of the energy required; electrical, fossil fuel and chemical manufacturing. The value is stated in average electrical power. A fossil fuel equivalent of 10,000 BTU per kilowatt hour was used; and 6.25 million BTU per ton of lime, 2,600 kilowatt-hours per ton of chlorine, and 32,000 BTU per ton of methanol for the required chemicals. Although not a total estimate of resource costs, this should serve as a good indicator. It is obvious that the total land treatment of wastewater for southeastern Michigan places a significantly greater demand on energy resources than any of the other options. Demands for other options, including use of land irrigation for smaller areas, are all within the same order of magnitude.

Perhaps the most significant problem associated with the collection and treatment of urban storm runoff would be that of supplying the power necessary to pump the peak storm flows to surface storage sites. For the

Table 16

RESOURCE DEMANDS SUMMARY

	ELECTRICAL POWER DEMAND		FOSSIL FUEL HEAT	CHEMICALS			EQUIVALENT ENERGY
	Peak	Average		Lime	Chlorine	Methanol	
	MW	MW	MM BTU	T/D	T/D	T/D	MW
AWT Alternative One	2,215	314	23,672	1,574	201	206	475
AWT Alternative Two	2,218	317	36,182	1,556	202	206	530
IPCT Alternative One	2,092	194	31,162	1,480	892	--	417
IPCT Alternative Two	2,053	153	31,057	1,498	892	--	376
IPCT Alternative Three	2,034	141	7,136	2,760	892	--	248
Land Alternative One	4,098	1,142	548	--	117	--	1,157
Land Alternative Two	2,849	544	7,619	420	236	--	612
Combination Alternative One	2,154	254	25,885	1,605	475	125	455
Combination Alternative Two	2,166	266	27,394	1,570	414	144	466
Combination Alternative Three	2,184	269	24,180	1,492	395	125	450
Combination Alternative Four	2,332	353	20,192	1,207	216	144	492

*Does not include Manpower associated with farming operations

system designed, the peak demand would be 1850 megawatts and would have to be available on short notice. A special peaking plant would thus be necessary to assure power availability and it would have to be of a diesel or gas turbine design since steam plants take too much time to reach peak output. The primary advantage of this system would be the addition of a significant emergency back-up capability to the regional power grid. This power demand would be a requirement of all of the preliminary alternatives. Thus no comparison could be made on this basis.

Employment

With the exception of the Interim Water Quality Plan, all of the preliminary alternatives were originally designed to be implemented by 1990. To meet the goals of P.L. 92-500, the systems would have to be operational by 1985. All of the alternatives with the exception of Land Irrigation Treatment Alternatives One and Two and Combination Treatment Alternative Four could be implemented in the new time frame. The exceptions would be due to additional tunneling required in those plans.

Implementation would require an intensive construction program and would result in excessive demands for both direct construction labor and labor which would be required for equipment fabrication and supply. With other major construction projects going on simultaneously, it is doubtful whether the labor demands could be met by the area. To estimate the relative labor demands for the preliminary alternatives, one can simply compare the total capital costs.

The large construction labor demands could have several effects on the area. The most obvious would be a demand for construction labor and a decrease in unemployment. An availability of jobs would also result in an inmigration of labor possibly causing locally heavy demands on housing and community services. Finally completion of the project could result in, at a minimum, a short-term unemployment problem especially in specialty labor

fields such as is required for tunnel construction.

Operating labor demands would not be excessive for any of the alternatives. Skill levels for both treatment plant operations and farming operations would have to be much higher than in the past. Plant equipment will be much more sophisticated and will require closer control and better appreciation of equipment functions. The requirements could be met by instituting training programs far enough in advance of the need. Farming operations would also be more sophisticated due to addition of irrigation equipment, large farm equipment, and the need of maintaining continuous crop cover.

SUMMARY OF MANPOWER REQUIREMENTS

	Total Manpower
AWT Alternative One	3728
AWT Alternative Two	3744
IPCT Alternative One	2218
IPCT Alternative Two	2293
IPCT Alternative Three	2436
Land Alternative One	1775*
Land Alternative Two	2083*
Combination Alternative One	3131
Combination Alternative Two	3283
Combination Alternative Three	3227*
Combination Alternative Four	3198*

*Total does not include manpower required for farming operations

Land and Water Use Changes

Of the preliminary alternatives, the least changes in land use would be caused by the Interim Water Quality Plan. The stormwater storage system would probably have the greatest impact, although planning is not yet site specific. Plant expansions would claim some residential commercial or industrial land in the vicinity of the plants; and the new plant near the mouth of the Huron River would probably displace agricultural land.

Of the alternatives designed to the "no discharge" goal, the Independent Physical-Chemical Alternatives would have the least impact on existing and planned land use. This is primarily due to the lesser demand for land to construct IPCT plants. Alternatives employing AWT at Detroit and Wyandotte would result in displacement of land presently in high density residential use. The displacement would have obvious negative effects; however, on the positive side, many of the residences affected are in need of repair or would be within ten years. The least desirable location for expansion to the AWT process would be Port Huron. Even if the plant were designed with space conservation as a goal, several acres of land would be required in a modern commercial area.

The Land Irrigation Treatment Alternatives would have the greatest impacts on land use. The lagoon systems required to support the land irrigation areas alone would require 143 square miles in Land Alternative One, 63 square miles in Land Alternative Two and 27 square miles in Combination Alternative Four. Although most of the land to be used for irrigation is presently in agricultural use, the type of operation would displace many residents and displacement of cash crops with forage crops would constitute a significant change in land use.

Buffer areas would be specified for most of the major facilities such as treatment plants, stormwater storage sites, treatment and storage lagoons and irrigation areas. Depending upon the degree of physical or hygienic risk involved in each case, these areas could be developed as open space or for recreation of different degrees of intensity.

Implementation of any of the alternatives would require that the major users of water from the Huron River find another souce of water. Present withdrawals are such that if urban wastewater were diverted downstream, the river could be exhausted during low flow periods. The major consumers, the communities of Ann Arbor and Ypsilanti, would have to establish an intake at the lake or contract with the Detroit Metropolitan Water Board.

All of the alternatives offer opportunities for reuse of treated wastewater. Irrigation treatment is in itself wastewater reuse. The alternatives emphasizing land irrigation employ large lagoon systems which offer a multiple use for industrial cooling. The possibility of using this water for power generation cooling has been discussed with the major suppliers in the area.

All alternatives with the exception of the Interim Water Quality Plan and Land Irrigation Treatment Alternative One offer an opportunity for development of an industrial water source near the stormwater treatment facilities near Ypsilanti and Plymouth. Industrial development in both of these areas has been restricted by a lack of available water.

Land Values

All of the alternatives would have the effect of improving land values along southeastern Michigan waterways by improving water quality. An additional value of the systems would be the reduction of peak flows attributable to urban runoff in the Rouge and Clinton Rivers. Some decrease in land values could be expected due to odor problems or the general stigma associated with wastewater. No general comparison between plans would be feasible since these effects would be local in nature.

Area Economy and Institutions

A sound basis exists for development of wastewater management on a regional basis in southeastern Michigan. The most severe problem to be

encountered in implementing an alternative which would not exceed the boundaries of the seven county area would be the acquisition of land required for wastewater treatment and stormwater storage facilities. More complex problems would result when wastewaters would have to be transported across major governmental boundaries for treatment, as would be the case for Land Irrigation Treatment Alternatives One and Two and Combination Treatment Alternative Four.

An additional problem, common in some degree to all of the alternatives would be the resistance from communities forced to abandon existing treatment plants. Communities such as Warren, Ann Arbor and Pontiac have already demonstrated resistance to centralized treatment as it constitutes a threat to political autonomy.

The question of loss of tax base would be a considerable factor since the land required for much of the system would be outside the boundary of the governmental unit in which the waste was generated. Table 17 shows the land areas required for each alternative broken out by county.

Table 17

ACRES REQUIRED BY COUNTIES

SYSTEM	LENAWEE	MACOMB	MONROE	OAKLAND	ST. CLAIR	WASHTENAW	WAYNE
AWT-1	5,370	6,425	6,285	3,675	3,539	2,995	3,080
AWT-2	2,408	6,425	6,285	3,675	3,215	2,995	3,080
IPC-1	2,643	6,425	6,350	3,675	3,153	2,995	2,660
IPC-2	2,706	6,425	6,172	3,675	3,182	2,995	2,770
IPC-3	13,343	6,425	6,172	3,675	4,408	2,995	2,770
LAND-1	20,395	23,545	61,304	3,675	131,063	2,910	2,575
LAND-2	11,330	23,705	61,524	3,675	127,706	2,995	2,660
COMB-1	4,378	6,425	6,235	3,675	3,358	2,995	2,980
COMB-2	4,659	6,425	6,210	3,675	3,309	2,995	3,080
COMB-3	9,350	6,425	6,210	3,675	25,516	2,995	3,080
COMB-4	13,922	6,425	58,988	3,675	73,314	2,995	3,300

Under the Land Treatment Systems publicly-owned land would also be required in:

	Huron Co.	Lapeer Co.	Sanilac Co.	Tuscola Co.
LAND-1	285,290	13,651	87,979	103,680
LAND-2	113,803	13,651	57,979	--

The construction program associated with implementation of one of the plans would have a significant effect on the local economy through increased payrolls, increased demand for construction materials and machinery, and secondary economic effects. Costs to individual families for wastewater treatment would increase since the local share of the construction cost and operation and maintenance costs would be paid through user charges. Impacts would be less for the Interim Plan than for the remainder of the preliminary alternatives.

Implementation of Land Alternative One or Two or Combination Alternative Four could cause an upheaval of the economy of the areas to be irrigated. A significant population shift would be necessary to expand the existing small farms so as to accommodate the large irrigation rigs proposed. The shift from small private farms to large commercial operations could have the effect of putting most small farm suppliers out of business. The cash crop oriented economy would have to shift to support an economy of primarily forage type crops.

Socio-Economics

Implementation of any of the preliminary alternatives would help to satisfy a regional need for expanded water based recreation. The primary contribution to that end would be the elimination of uncontrolled discharge from combined sewers as a source of surface water pollution. Most public bathing areas now closed because of water quality conditions could be reopened.

The most significant social problem to result from implementation of one of these alternatives would be the relocation of residents of land required for construction of facilities. No estimate was made of the number of families which would be affected by any of the alternatives so no real comparisons are possible. It is obvious, however, that the IPCT alternatives would have the least impact since they would require the least amount of land for expansion of existing facilities and since they offer

the greatest flexibility in site selection. Alternatives requiring significant expansion of existing plants would impact on adjacent residential areas. Land irrigation alternatives would require the largest parcels of land; however, residential densities would be much lower.

System Costs

The cost of implementing any of these systems would be great in both dollars and resource consumption. Table 18 summarizes the costs estimated for each alternative. Costs presented are based on an interest rate of 5-1/2 percent over the project design life of 50 years.

TABLE 18

SYSTEM COSTS SUMMARY

	Construction Cost Million Dollars	Amortized Construction Cost Million Dollars	Amortized Replacement Cost Million Dollars	Annual Operation and Maintenance Million Dollars	Total Annual Treatment Cost Million Dollars
AWT Alternative One	4,237	250.2	2.3	117.6	370.1
AWT Alternative Two	4,244	250.7	2.6	121.4	374.7
IPCT Alternative One	4,263	251.6	5.1	119.1	375.8
IPCT Alternative Two	4,040	238.6	5.6	113.5	357.7
IPCT Alternative Three	3,987	235.5	3.0	108.1	346.6
Land Alternative One	6,028	358.4	10.4	155.0	523.8
Land Alternative Two	5,507	325.8	4.8	110.4	441.0
Combination Alternative One	4,175	246.6	3.7	114.8	365.1
Combination Alternative Two	4,189	247.4	3.6	117.7	368.7
Combination Alternative Three	4,262	251.7	3.8	118.0	373.5
Combination Alternative Four	4,568	269.8	3.3	109.7	382.8

Chapter VIII

REVISED CONCEPT FOR LAND IRRIGATION TREATMENT

Development Methodology

Evaluation of the land irrigation treatment systems designed for the preliminary alternatives revealed disadvantages sufficient to warrant re-examination of the concept. It was decided that the concept would be revised so that the major disadvantages could be avoided. In the revised concept, the individual farmer would be allowed to maintain title to his land and would retain much of the control he held previously. The farmer would contract with the operating agency to receive a set amount of wastewater on a somewhat flexible schedule. The farmer would be allowed to select the crops he wished to grow and his planting and harvesting schedule.

The advantages gained in addition to those of the previous design would be that: no mass purchase of land would be necessary; there would be no loss of land from local tax rolls because of irrigation land purchase; residents would not be forced to relocate; cropping patterns in the area would not be altered or controlled; local farm suppliers would not be affected; and there would be an increase in agricultural yield.

Toward that end, the District contracted with a group of crop and soil scientists at Michigan State University and Dow Engineering, Inc., to develop and design land irrigation systems on this new concept. A twenty-five county area was studied for potential irrigation. Land was divided into treatment zones having similar characteristics and irrigation facilities were designed for the zones. Wastewater application rates for a particular zone were based on the amount of water the soil could accept, the ability of the soil and crops to achieve the desired wastewater renovation, the type of crop projected for the area, and the need for drainage.

Two systems were investigated using the private ownership concept of land irrigation treatment for all wastewater and urban storm runoff generated in the Southeastern Michigan area. In one alternative, Land Irrigation Treatment Alternative Three, aerated lagoons, as described in previously presented land irrigation plans, would be used to achieve secondary treatment prior to irrigation. The second alternative would make use of existing secondary treatment plants for treatment of municipal-industrial wastewater prior to irrigation. Urban runoff would only receive the equivalent of primary treatment at stormwater storage sites prior to final storage and irrigation.

Land Irrigation Treatment Alternative Three

This alternative was designed for use of the revised Land irrigation concept for all municipal-industrial wastewater and urban storm runoff from the area. The primary purpose was to allow comparison with Land Irrigation Treatment Alternative One.

The plan (see figure 12) would use a wastewater collection and transmission system and a stormwater collection and storage system identical to that designed for Land Alternative One. From the regional storage lagoons in Macomb and Monroe Counties, wastewater would be conveyed to treatment lagoon systems in St. Clair and Monroe Counties. A smaller treatment lagoon system would be located east of Adrian to serve the Adrian-Tecumseh area. From the treatment lagoons wastewater would be transferred to storage lagoon systems at the treatment lagoon sites, transferred to a storage site near Frankenmuth, or distributed for irrigation. The 1,616,400 acres of irrigation land would be distributed over a twenty-one county area.

Disinfection procedures would be more stringent since wastewater distribution would be over a wider area and exposure would be increased. Following treatment, ozone would be added to kill most of the bacteria and

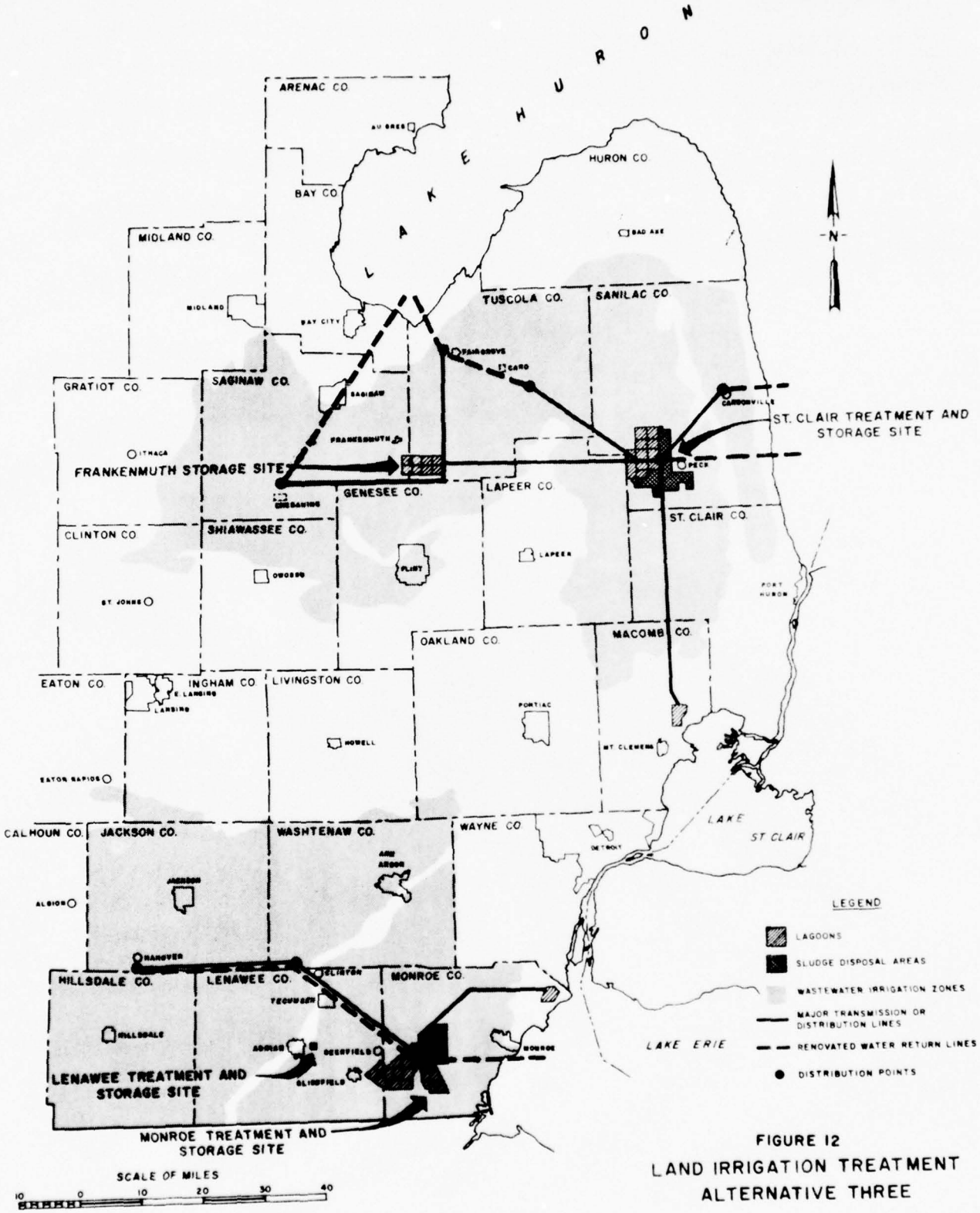

FIGURE 12
LAND IRRIGATION TREATMENT
ALTERNATIVE THREE

virus. Prior to distribution to the irrigation areas, sufficient chlorine would be added so as to insure a residual through the distribution system.

Following irrigation, the renovated percolate would be collected in a tile drainage system and returned to a collection point. From the collection point, the renovated water could either be added to local rivers and streams for flow augmentation or transferred to a pipeline capable of returning the total flow to a major water body.

Sludges generated at the lagoon treatment sites would be handled, as in previous land irrigation designs, by application to land adjacent to the lagoons.

The impact table, Table 19, outlines the major impacts identified by the evaluation team. Also listed are costs, energy demands and chemical requirements.

Comparison of Land Irrigation Alternatives

Due to the similarity of the two land irrigation treatment plans, many of the impacts would not differ significantly between the alternatives. The major differences, identified by the evaluators, center around the affected agricultural community. The only factors which would directly affect the southeastern Michigan service area would be related to system costs and energy demands.

The evaluators from the University of Michigan School of Public Health pointed out several disadvantages or areas of concern generated by revision of the land irrigation concept. Of major concern was the increased human exposure to the incompletely disinfected wastewater. Exposure would be increased both due to the larger area required under the revised concept and increased exposure of residents allowed to live on the farms to be irrigated. Possibilities for spread of disease by animals and water-

TABLE 19
LAND IRRIGATION TREATMENT ALTERNATIVE THREE
IMPACT IDENTIFICATION TABLE

	THE IMMEDIATE VICINITY OF A WASTEWATER FACILITY	THE AREA IN SOUTHEASTERN MICHIGAN SERVED BY THE WASTEWATER SYSTEM	DIRECTLY AFFECTED AREAS OUTSIDE THE SERVICE AREA
I. WATER QUALITY			
A. SURFACE WATERS		Significant improvements could be expected in the water quality in the St. Clair, Clinton, Rouge, Huron, Detroit and Raisin Rivers due to elimination of urban stormwater and wastewater discharges.	
		Peak storm flows would be equalized in the Rouge, Huron and Clinton Rivers due to stormwater storage facilities.	
			An increase in stream baseflow may be experienced in areas under irrigation.
B. GROUND WATER	Some water from irrigated areas may reach ground waters but would only affect quantity not quality.		
	Ground water contamination could result from poorly managed sludge application areas and sludge landfills (primarily nitrates and heavy metals).		
II. AQUATIC LIFE AND WATERFOWL		Habitats for intolerant game fish would be improved; however, artificial stocking would be required to maintain populations.	
III. PUBLIC HEALTH		Pathogen contamination from treatment plant effluents and uncontrolled discharge of urban storm runoff and combined sewer overflow would be virtually eliminated.	
			Infectious disease could be spread by waterfowl or game animals allowed access to stormwater storage lagoons, wastewater treatment and storage lagoons, sludge disposal areas, and wastewater conveyance ditches.
	A potential hazard would exist where large quantities of chlorine would be handled. (On site chlorine production would significantly reduce the hazards).		
		Increased concentrations of pathogens could be expected in the air in the vicinity of AWT aeration basins, aerated lagoons, and irrigation activities.	
			The decentralized control in the land irrigation system proposed could result in more frequent ponding of wastewater and increased potential for mosquito breeding.
			Hygienists warn that direct consumption of crops grown on wastewater irrigated land may be dangerous due to incomplete disinfection prior to irrigation and potential crop uptake of harmful materials.
IV. ENERGY AND NATURAL RESOURCES A. AIR		Sewage sludge incineration would be eliminated as a source of atmospheric pollution.	
B. CHEMICALS		25,000 tons of chlorine (or raw materials, salt and electrical energy: 2600 kwhr/ton Cl_2) would be consumed annually.	

The comments in this table are intended to identify impacts only; each comment appears under the column identifying the area of greatest significance. The relative significance for other areas is identified by the screening indicated in the index to the right.

Equally Significant

Somewhat Significant

Partially Significant

Insignificant

THE REST OF THE STATE OF MICHIGAN	THE LAKE ERIE BASIN	THE NATION	CANADA - INTERNATIONAL
This plan would result in water of higher quality than presently required by the State of Michigan.		This plan meets the intent and time phased goals of Public Law 92-500.	This plan would comply with the April 1972 agreement with Canada on Great Lakes water quality.
	There is little potential for significant improvement in the western half of Lake Erie with respect to algal blooms and oxygen depletion.		
	This alternative offers the greatest potential for ecological recovery in the eastern half of Lake Erie but would depend upon implementation of similar plans throughout the basin.		
	Although the habitat for intolerant fishes would be improved in Lake Erie, improvement of fisheries will depend on management practices in the commercial fishing industry.		
	Waterfowl populations may improve due to improved habitats and food supplies.		

TABLE 19 (CONTINUED)
LAND IRRIGATION TREATMENT ALTERNATIVE THREE
IMPACT IDENTIFICATION TABLE

	THE IMMEDIATE VICINITY OF A WASTEWATER FACILITY	THE AREA IN SOUTHEASTERN MICHIGAN SERVED BY THE WASTEWATER SYSTEM	DIRECTLY AFFECTED AREAS OUTSIDE THE SERVICE AREA
			Phosphorus and nitrogen in the irrigated wastewater would be recycled into the environment reducing the need for commercial fertilizers.
C. ELECTRICAL POWER		The average electrical power demand of 658 megawatts is within the planned capabilities of Detroit Edison.	
		The additional 1880 megawatts required for peak stormwater pumping would be met by stand-by generators which could also serve as emergency back-up to the regional power grid.	
D. FUEL OIL OR NATURAL GAS		Fuel oil for operation of trucks and tractors would total less than 1 billion BTU per day.	
V. EMPLOYMENT		Labor demands for construction would cover a period of 10-12 years. The demands for that period would exceed the local supply thus requiring labor from outside the region.	
		Unemployment in the construction trades would be expected to drop with the advent of construction and increase upon completion of the project.	
		The total operating manpower required would be 2815. Special training programs would be necessary to meet demands for technicians and specialty labor categories.	
VI. LAND AND WATER USE CHANGES	Land use would be most markedly changed by the construction of stormwater storage facilities in and around the urbanized area (24,500 acres), and by construction of treatment and storage lagoon in Sanilac (49,000 acres), and Monroe (49,500 acres) Counties.		
		Buffer areas specified for most wastewater facilities have potential use by local units of government for open space or recreational areas.	
		Implementation of this plan would necessitate development of a supplementary water source for the Ann Arbor-Ypsilanti area to avoid abnormally low flows in the Huron River.	
	A potential would exist for developing the lagoon systems in St. Clair and Monroe Counties for use as industrial cooling water for power generation or similar operations.		
VII. LAND VALUES		Land values along southeastern Michigan shorelines should increase due to improved water quality over the area and peak flow reduction in the Rouge and Clinton Rivers.	
	Some loss of property value may be experienced in the vicinity of wastewater management facilities due to the stigma associated with such facilities.		
			The irrigation and drainage systems proposed would increase the amount of productive agricultural land and greatly increase productivities on irrigated land.
VIII. AREA ECONOMY AND INSTITUTIONS		The history of growing intergovernmental cooperation in southeastern Michigan lays the basis for a regional approach to wastewater management.	
		Implementation and operation of this alternative would require one or several management organizations having a number of comprehensive management capabilities (i.e. planning, financing, construction, operation, maintenance and administrative capabilities).	
		Implementation of this plan would be contrary to the goals of some communities, particularly Ann Arbor, Pontiac and Warren, which desire to maintain autonomy.	
			140,000 Acres of land would be removed from the tax base of local and county governments. The major effect would be felt in Sanilac and Monroe Counties.

The comments in this table are intended to identify impacts only; each comment appears under the column identifying the area of greatest significance. The relative significance for other areas is identified by the screening indicated in the index to the right.

Equally Significant

Somewhat Significant

Partially Significant

Insignificant

THE REST OF THE STATE OF MICHIGAN	THE LAKE ERIE BASIN	THE NATION	CANADA (INTERNATIONAL)

TABLE 19 (CONTINUED)
LAND IRRIGATION TREATMENT ALTERNATIVE THREE
IMPACT IDENTIFICATION TABLE

	THE IMMEDIATE VICINITY OF A WASTEWATER FACILITY	THE AREA IN SOUTHEASTERN MICHIGAN SERVED BY THE WASTEWATER SYSTEM	DIRECTLY AFFECTED AREAS OUTSIDE THE SERVICE AREA
		All existing treatment facilities in the service area would be phased out by 1985.	
		The regional economy would be stimulated temporarily due to demands for construction materials and increased construction payrolls.	
		Gross income in the area would increase due to increased wastewater system payrolls; however, there would be an area-wide decrease in disposable *income of each family* due to increased sewer charges to offset costs shown under X. below.	
		The creation of an unpolluted water supply would not have a significant effect on existing economic enterprises, nor is it apt to attract new types of economic activity.	
			Increased production would stimulate local agricultural commerce (e.g. seed, fertilizer and machinery supply, crop disposition, etc.).
IX. SOCIO-ECONOMICS	Owners of economic establishments and residents of lands required for construction of wastewater facilities would have to be relocated.		
	Residents of lands near proposed facilities would have their normal lifestyle disrupted and commercial enterprises near-by would be affected while construction operations were underway.		
		The system would help satisfy a regional need for expanded water-based *recreation by providing more* waters suitable for total body contact recreation.	
			With the advent of irrigation scheduling of farm operations and equipment operation and maintenance would become more sophisticated requiring that the farmer be a better farm manager and requiring greater skill level from farm labor.
X. SYSTEM COSTS			
A. CAPITAL COSTS		$2,522,000,000	
B. AMORTIZED CAPITAL COST (Average annual)		149,000,000	
C. OPERATION AND MAINTENANCE (Average annual)		294,000,000	
D. TOTAL AVERAGE ANNUAL COST		443,000,000	

The comments in this table are intended to identify impacts only; each comment appears under the column identifying the area of greatest significance. The relative significance for other areas is identified by the screening indicated in the index to the right.

Equally Significant 

Somewhat Significant 

Partially Significant 

Insignificant 

THE REST OF THE STATE OF MICHIGAN	THE LAKE ERIE BASIN	THE NATION	CANADA - INTERNATIONAL
		$7,566,000,000 447,000,000 – – 447,000,000	

fowl gaining access to partially treated wastewater would be increased, also due to the increased exposure area. The reduction in control over operations could also lead to increased opportunities for mosquito breeding in areas where wastewater could accumulate. The primary concern, however, would be with the direct consumption of food crops directly irrigated with wastewater or contaminated by an adjacent wastewater irrigation system. Thorough disinfection was considered a necessity for any wastewater irrigation project, but especially so for a project allowing wide exposure to the wastewater.

With the exception of the increased hygienic risks just described, the revision of the land irrigation treatment concept would be an improvement over the earlier total control concept. Land in public ownership required for Land Alternative One would be 736,000 acres compared to 140,000 acres for Land Alternative Three. Implicit in the reduction is required land would be: a decrease in loss of tax base by local governmental units, and a decrease in the number of families and commercial enterprizes displaced.

Several improvements were made in the design which would improve compatibility of the land irrigation system with the existing agricultural economy. First and foremost, agricultural cropping patterns would not be altered to suit irrigation needs; rather, land to be irrigated was selected to fit current and projected cropping patterns. This would avoid the major shift to forage type crops identified in the evaluation of Land Alternative One.

Land Alternative Three would offer another advantage over Land Alternative One in that the size of farm would not be altered. A shift to larger farm operations as would be the case in Land Alternative One, would probably cause the elimination of the existing small farm suppliers in favor of bulk purchase practices. Land Alternative Three would probably have a positive effect on the rural communities in that cash flow would probably increase and more jobs would be available as would be required to support the irrigation system.

Land Alternative Three offers a significant savings in electrical power requirements over Land Alternative One. The average demand was reduced from 1142 megawatts to 660 megawatts. Peak demand of an additional 1850 megawatts would still be required for operation of the storm runoff storage system.

The system costs increased significantly in Land Alternative Three to a capital cost of $10 billion from a cost of 6 billion for Land Alternative One. The total annual cost also increased from 524 million to $890 million. These costs were based on the assumption that the farmer would contract with the operating authority and would receive all irrigation and drainage equipment in exchange for agreeing to accept up to a specified maximum quantity of wastewater annually. The operation and maintenance costs allow for maintenance of all irrigation and drainage equipment and the power consumed in irrigation. A variation of the contract with the individual farmer could have a significant effect in raising or lowering the cost to the wastewater management agency for operation of the system.

Land Irrigation Treatment Using Existing Plants for Pre-Treatment

As previously mentioned, an alternative was considered which would make use of the existing secondary treatment plants in southeastern Michigan rather than building aerated lagoons to perform that function. The planning was not carried beyond a preliminary stage which would allow evaluation of the feasibility of such a plan.

To implement a plan of this type, several sacrifices would have to be made in the quality of pretreatment achieved to avoid excessive additional costs. Daily municipal-industrial flows would receive high quality secondary treatment; however, to allow dual use of the major transmission lines to the storage system and irrigation areas, it would be necessary to give storm flows only the equivalent of primary treatment in the stormwater equalization lagoons. This would not greatly affect the average quality of irrigation water. Disinfection would be necessary prior to distribution.

There would be no significant change in impacts by implementing this plan over those of Land Alternative Three. The advantages would be: the use of existing plants rather than disposing of them and conveyance of treated wastewater to storage areas rather than raw wastewater. There would be no significant reduction in land required for the Monroe and St. Clair County lagoon systems since storage lagoons would still be necessary and the aerated lagoons required only a small percentage of the total required land. Land required for sludge would be significantly reduced since incineration would be employed at treatment plant sites rather than land application at the lagoon sites.

Total energy requirements would not change significantly. The location of the demands would be shifted from lagoon sites to treatment plant sites. Those resource demands affected by the use of incineration, such as fuel and air emissions, would change.

The total cost of the system, both capital and operational would not be expected to change significantly.

Chapter IX

DEVELOPMENT OF FINAL ALTERNATIVES

Following a thorough study of the available evaluation data, several conclusions were drawn:

1. A wastewater management plan for treating the entire municipal, industrial, and separate and combined stormwater flow from the eight county southeastern Michigan area by land treatment is not socially or politically acceptable at this time and it may not be the most cost effective system.

2. Land treatment, as designed in this study is acceptable and feasible on a smaller scale for use in specific portions of the study area.

3. For those wastewater plans involving complete or partial use of "Plant type" processes, the following conclusions are appropriate:

a. In most cases where an existing treatment plant site is to be retained, the advanced waste treatment (AWT) technology is the most feasible approach. (The exception to this is at Port Huron because of the limited availability of land);

b. Where completely new plants are required, Independent Physical-Chemical Treatment is the most feasible technology;

c. Because of availability of land and location of the treatment plants, the most feasible method of sludge disposal from "plants" is incineration and landfill;

d. In the rapidly urbanizing areas, the most appropriate method of treating combined sewer overflows and urban stormwater runoff is

through short-term storage and treatment, on an intermittent flow basis, in IPCT plants.

4. The Interim Water Quality Plan should be considered as an alternative to progressing to "no discharge" of pollutants to navigable waters.

From these conclusions, three wastewater plans were developed to be presented as final plans along with the Interim Water Quality Plans. The three plans were designated as Representative Plans since they were considered representative of the most desirable parts of the preliminary plans presented earlier.

Representative Plans

The three representative alternative plans differ in the method of treatment employed in the Adrian-Tecumseh area and in the southern portion of St. Clair County while much of the other facilities are the same. Thus, the representative plans could be considered as one plan with three variations or sub-systems. Common to each representative plan is the use of three existing wastewater treatment plants located in Detroit (W. Jefferson Avenue), Wyandotte, and Monroe. These plants would be upgraded to advanced wastewater treatment plants to make use of the existing facilities, especially those which have just been added or are currently under construction. The existing wastewater treatment plant in Port Huron would be converted to an independent physical-chemical treatment plant because the additional land required for adding advanced wastewater processes to the existing secondary facilities would not be easily acquired. A new plant at the Huron River would also be common to all plans. This plan would be an independent physical-chemical facility because it is the most cost effective method of providing treatment for that area.

All treatment facilities have been designed to meet a minimum effluent standard of:

BOD	4 mg/l
COD	10 mg/l
Suspended Solids	2 mg/l
Total Phosphorus	0.1 mg/l
Ammonis Nitrogen	0.3 mg/l
Total Nitrogen	3.0 mg/l

In addition, most heavy metals, synthetic organic chemicals and pesticides would be reduced to trace levels; and the effluent would be relatively free of pathogens.

Most of the interceptor sewer system necessary for the plans will already be in place by 1985. The additional major interceptor construction necessary for implementation of the plans would include: an interceptor along the shoreline in southern St. Clair County to the East China plant, an interceptor along the Detroit River to the Huron River plan, an interceptor from Ann Arbor following the Huron River to its mouth and an interceptor following Hannan Road north of the Huron River.

The system designed for handling combined sewer overflow and urban storm runoff would be essentially independent of the municipal-industrial wastewater treatment system. The stormwater system would utilize forty-nine community storage reservoirs ranging in size from 80 to 690 acres. These and two regional reservoirs of 3,120 acres each would be used for temporary storage of peak storm flows. Four stormwater treatment facilities would also be common to all plans. They would be independent physical-chemical treatment facilities because advanced wastewater treatment for stormwater cannot be operated in a manner that responds satisfactorily to the intermittent nature of stormwater flows. One of these plants would be constructed as part of regional facilities at the Huron River because similar treatment processes make it economically advantageous and more efficient to integrate portions of the separate treatment facilities. Another

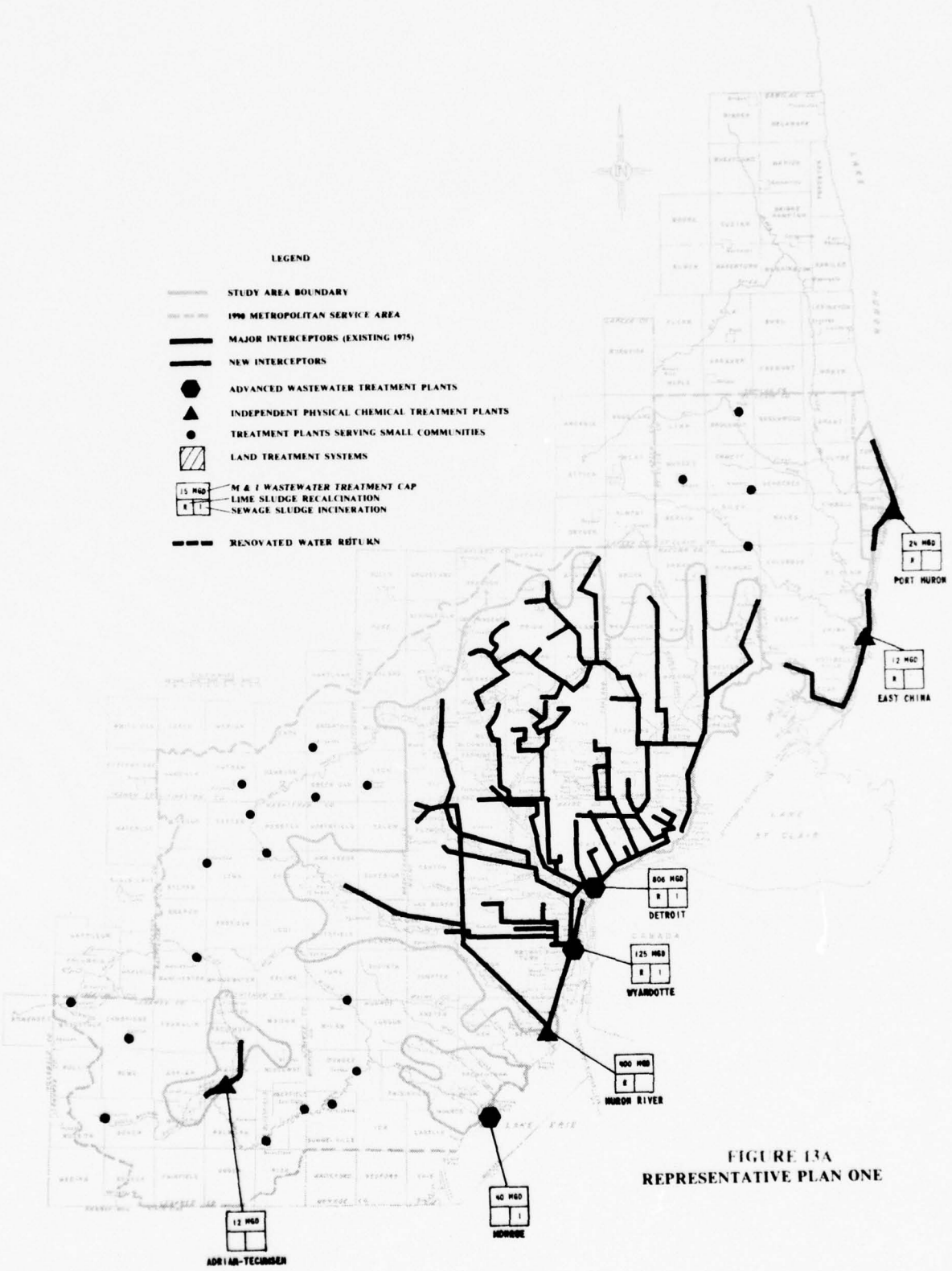

FIGURE 13A
REPRESENTATIVE PLAN ONE

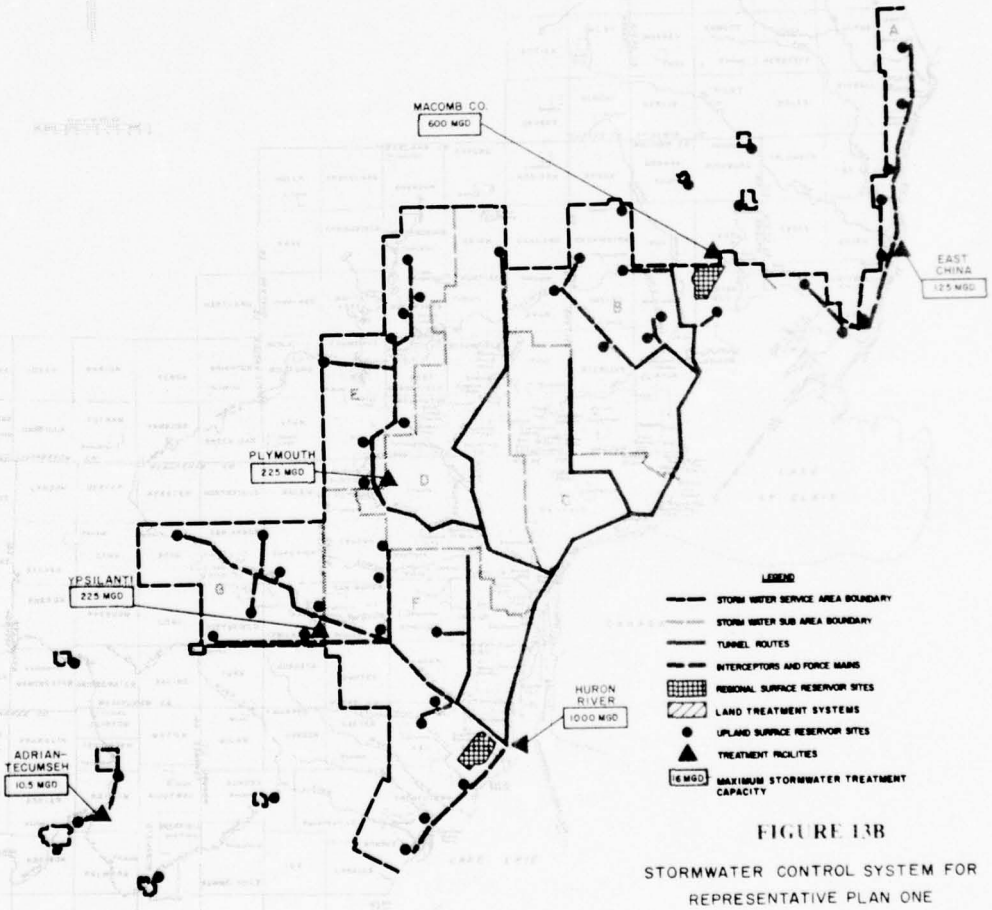

FIGURE 13B

STORMWATER CONTROL SYSTEM FOR REPRESENTATIVE PLAN ONE

plant would be located at the regional storage reservoir in Macomb County for most efficient operation. The remaining stormwater plants would be independent facilities located near Plymouth and Ypsilanti. These plants would discharge a treated stormwater effluent which would have normally been a part of the natural flow of the river. The discharge rate would be more uniform, however, and the quality much higher.

An extensive system of interceptors and tunnels would be required to collect storm runoff and combined sewer overflows at the present points of discharge to surface waters. Normal sewer construction techniques would be utilized in less urbanized areas; however, the greater size of sewers required in highly urbanized areas and the construction problems encountered made design of hard rock tunnels necessary.

Sludges generated at the common wastewater treatment plants would be incinerated in order to reduce the amount of land required for filling the sludge and to reduce hygienic hazards from handling the sludge. All sludges from lime clarification processes would be recalcined both to reclaim the lime and to reduce the volume of waste sludge. The solids which would accumulate in stormwater storage lagoons would be removed periodically and disposed of in a landfill.

Representative Plan 1

Representative Plan 1, shown in figures 13A and B, emphasizes wastewater treatment by plants on a regional scale. In addition to the facilities common to each plan, small communities outside the regional service area would operate individual treatment plants until growth might warrant extension of regional interceptors.

The regional service areas in Lenawee County and south St. Clair County would be serviced by independent physical-chemical treatment plants east of Adrian and at East China Township. The IPCT process would be the

TABLE 20

REPRESENTATIVE PLAN ONE
IMPACT IDENTIFICATION PLAN

	THE IMMEDIATE VICINITY OF A WASTEWATER FACILITY	THE AREA IN SOUTHEASTERN MICHIGAN SERVED BY THE WASTEWATER SYSTEM	DIRECTLY AFFECTED AREAS OUTSIDE THE SERVICE AREA
I. WATER QUALITY			
A. SURFACE WATERS		Significant improvements could be expected in the water quality in the St. Clair, Clinton, Rouge, Huron, Detroit and Raisin Rivers due to elimination of urban stormwater and wastewater discharges.	
		Peak storm flows would be equalized in the Rouge, Huron and Clinton Rivers due to stormwater storage facilities.	
B. GROUNDWATER	Ground water contamination could result from poorly managed sludge landfill areas (primarily nitrates and heavy metals).		
II. AQUATIC LIFE AND WATERFOWL		Habitats for intolerant game fish would be improved; however, artificial stocking would be required to maintain populations.	
III. PUBLIC HEALTH		Pathogen contamination from treatment plant effluents and uncontrolled discharge of urban storm runoff and combined sewer overflow would be virtually eliminated.	
		Infectious disease could be spread by waterfowl or other animals allowed access to stormwater storage lagoons.	
	A potential hazard would exist where large quantities of chlorine would be handled (On site chlorine production would significantly reduce the hazards).		
	Increased concentrations of pathogens could be expected in the air in the vicinity of treatment plant aeration basins.		
IV. ENERGY AND NATURAL RESOURCES			
A. AIR		Some gaseous (NO_x and SO_x) and particulate matter would be emmitted from incineration, lime sludge recalcination and carbon regeneration facilities at treatment plant sites.	
	A plume would be visible at incineration and lime sludge recalcination sites due to condensed water vapor.		
B. CHEMICALS		155,400 tons of chlorine (or raw materials, salt and electrical energy: 2600 kwhr/ton Cl_2) would be consumed annually.	
		570,000 tons of lime (or raw materials, limestone rock and heat energy: 4.25-8.25 million BTU/ton lime) would be consumed annually.	
		81,000 tons of methanol (brewery waste could be substituted) would be consumed annually.	
C. ELECTRICAL POWER		The average electrical power demand of 265 megawatts is within the planned capabilities of Detroit Edison.	

The comments in this table are intended to identify impacts only; each comment appears under the column identifying the area of greatest significance. The relative significance for other areas is identified by the screening indicated in the index to the right.

Equally Significant

Somewhat Significant

Partially Significant

Insignificant

THE REST OF THE STATE OF MICHIGAN	THE LAKE ERIE BASIN	THE NATION	CANADA - INTERNATIONAL
This plan would result in water of higher quality than presently required by the State of Michigan.		This plan meets the intent and time phased goals of Public Law 92-500.	This plan would comply with the April 1972 agreement with Canada on Great Lakes water quality.
	There is little potential for significant improvement in the western half of Lake Erie with respect to algal blooms and oxygen depletion.		
	If similar wastewater management projects were carried out in the remainder of the Lake Erie basin, ecological recovery may be possible in the eastern half of the lake.		
	Although the habitat for intolerant fishes would be improved in Lake Erie, improvement of fisheries will depend on management practices in the commercial fishing industry.		
	Waterfowl populations may improve due to improved habitats and food supplies.		

TABLE 20

REPRESENTATIVE PLAN ONE
IMPACT IDENTIFICATION TABLE
(CONTINUED)

	THE IMMEDIATE VICINITY OF A WASTEWATER FACILITY	THE AREA IN SOUTHEASTERN MICHIGAN SERVED BY THE WASTEWATER SYSTEM	DIRECTLY AFFECTED AREAS OUTSIDE THE SERVICE AREA
C. ELECTRICAL POWER (Continued)		The additional 1850 megawatts required for peak stormwater pumping would be met by stand-by generators which could also serve as emergency back-up to the regional power grid.	
D. FUEL OIL OR NATURAL GAS		33 billion BTU of heat energy from fuel oil or natural gas would be required daily.	
V. EMPLOYMENT		Labor demands for construction would cover a period of 10-12 years. The demands for that period would exceed the local supply thus requiring labor from outside the region.	
		Unemployment in the construction trades would be expected to drop with the advent of construction and increase upon completion of the project.	
		The total operating manpower required would be 3249. Special training programs would be necessary to meet demands for technicians and specialty labor categories.	
VI. LAND AND WATER USE CHANGES	Essentially all of the proposed facilities would somewhat alter existing and proposed land use.		
		Buffer areas specified for most wastewater facilities have potential use by local units of government for open space or recreational areas.	
		Implementation of this plan would necessitate development of a supplementary water source for the Ann Arbor-Ypsilanti area to avoid abnormally low flows in the Huron River.	
	A potential would exist for developing local industrial water supplies utilizing renovated wastewater particularly in the vicinity of facilities near Adrian, Ypsilanti, Plymouth and the Huron River. Industrial expansion could thus be encouraged in areas previously not industrially oriented.		
VII. LAND VALUES		Land values along southeastern Michigan shorelines should increase due to improved water quality over the area and peak flow reduction in the Rouge and Clinton Rivers.	
	Some loss of property value may be experienced in the vicinity of wastewater management facilities due to the stigma associated with such facilities.		
VIII. AREA ECONOMY AND INSTITUTIONS		The history of growing intergovernmental cooperation in southeastern Michigan lays the basis for a regional approach to wastewater management.	
		Implementation and operation of this alternative would require one or several management organizations having a number of comprehensive management capabilities (i.e. planning, financing, construction, operation, maintenance and administrative capabilities).	
		Implementation of this plan would be contrary to the goals of some communities, particularly Ann Arbor, Pontiac and Warren, which desire to maintain autonomy.	
		28,200 acres of land would be removed from the tax base of local and county governments.	
		All existing treatment facilities in the service area with the exception of Detroit, Wyandotte, Port Huron and Monroe would be phased out by 1985.	
		The regional economy would be stimulated temporarily due to demands for construction materials and increased construction payrolls.	

THE REST OF THE STATE OF MICHIGAN	THE LAKE ERIE BASIN	THE NATION	CANADA - INTERNATIONAL

TABLE 20

REPRESENTATIVE PLAN ONE
IMPACT IDENTIFICATION TABLE
(CONTINUED)

	THE IMMEDIATE VICINITY OF A WASTEWATER FACILITY	THE AREA IN SOUTHEASTERN MICHIGAN SERVED BY THE WASTEWATER SYSTEM	DIRECTLY AFFECTED AREAS OUTSIDE THE SERVICE AREA
VIII. AREA ECONOMY AND INSTITUTIONS (Continued)		Gross income in the area would increase due to increased wastewater system payrolls; however, there be an area-wide decrease in disposable income of each family due to increased sewer charges to offset costs shown under X. below.	
		The creation of an unpolluted water supply would not have a significant effect on existing economic enterprizes, nor is it apt to attract new types of economic activity.	
IX. SOCIO-ECONOMICS	Owners of economic establishments and residents of lands required for construction of wastewater facilities would have to be relocated.		
	Residents of lands near proposed facilities would have their normal lifestyle disrupted and commercial enterprizes near-by would be affected while construction operations were underway.		
		The system would help satisfy a regional need for expanded water based recreation by providing more waters suitable for total body contact recreation.	
X. SYSTEM COSTS			
A. CAPITAL COSTS		$ 1,046,000,000	
B. AMORTIZED CAPITAL COST (Average annual)		62,000,000	
C. OPERATION AND MAINTENANCE (Average annual)		123,000,000	
D. TOTAL AVERAGE ANNUAL COST		185,500,000	

THE REST OF THE STATE OF MICHIGAN	THE LAKE ERIE BASIN	THE NATION	CANADA – INTERNATIONAL
		$ 3,137,000,000 185,000,000 185,000,000	

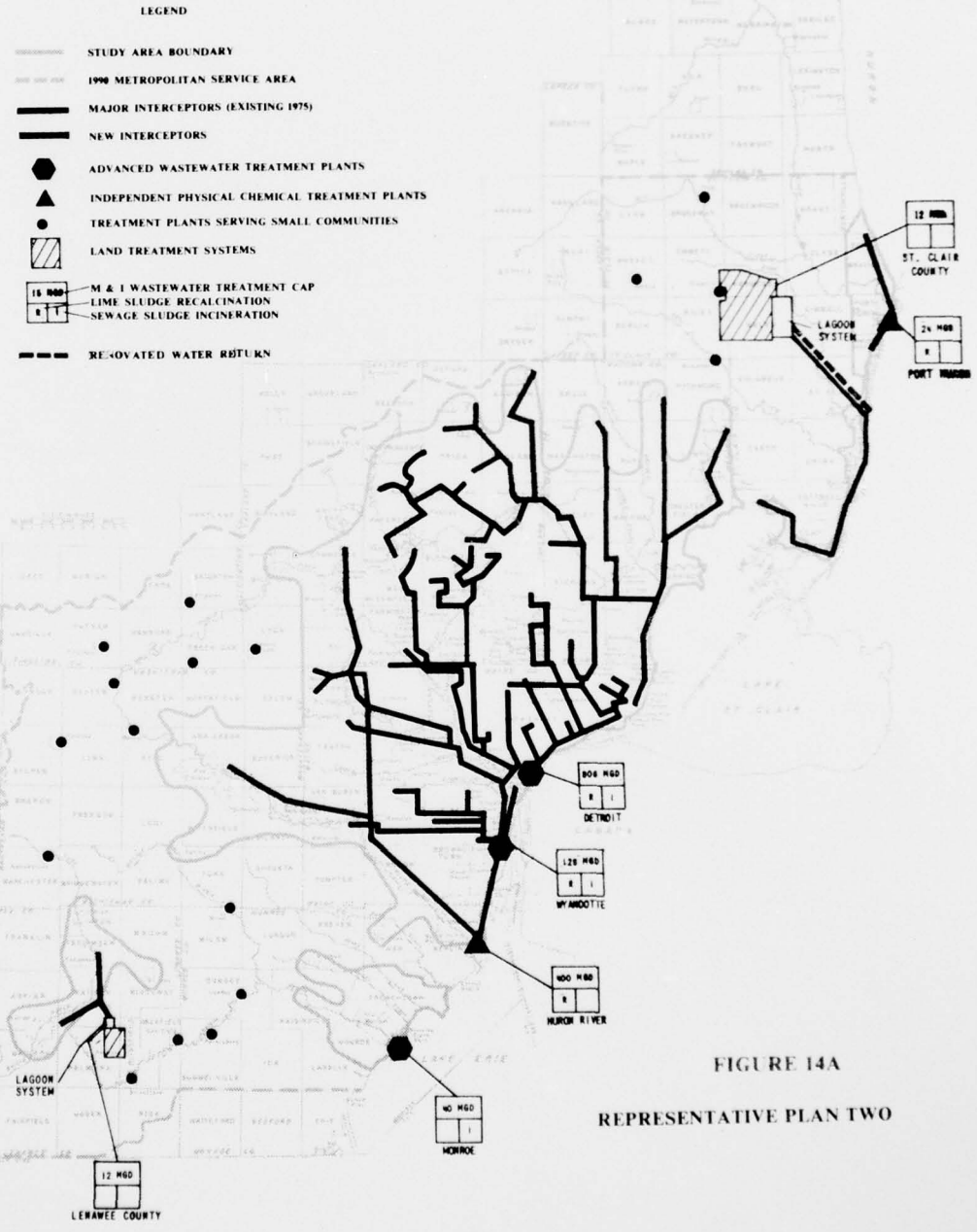

FIGURE 14A

REPRESENTATIVE PLAN TWO

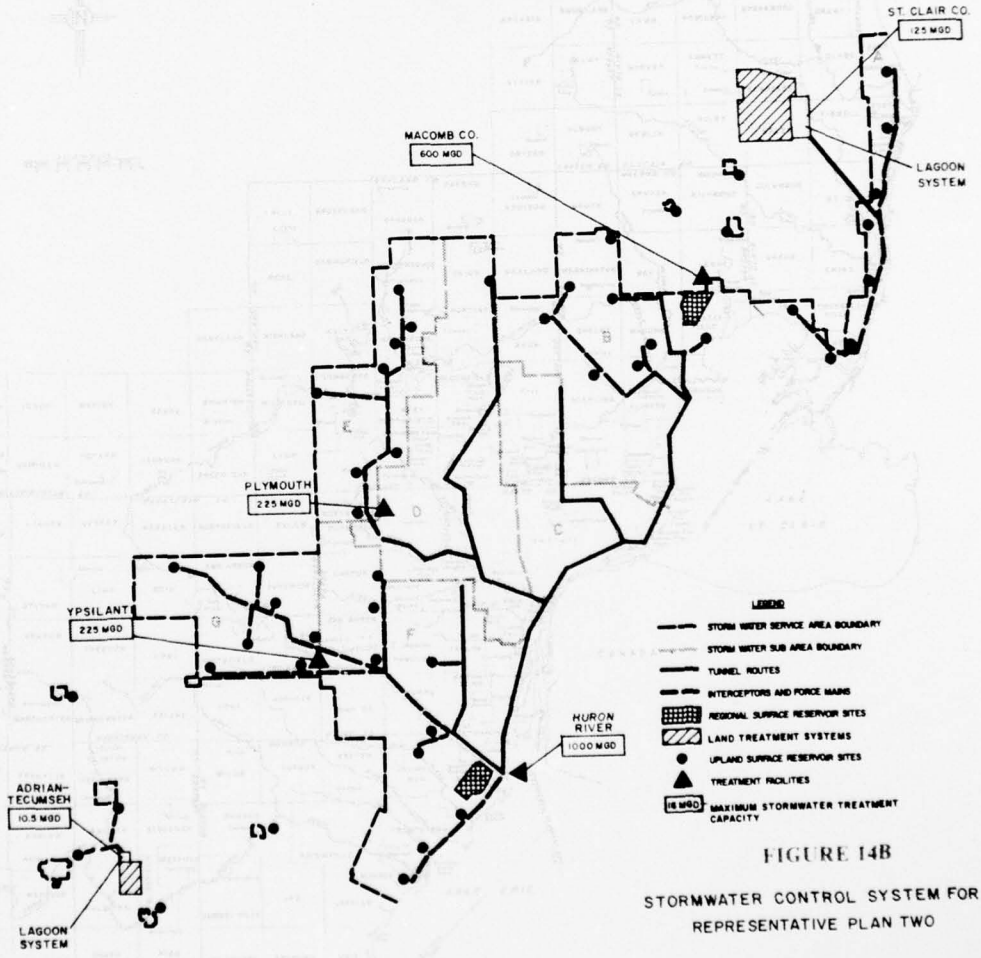

FIGURE 14B

STORMWATER CONTROL SYSTEM FOR REPRESENTATIVE PLAN TWO

most economical type of treatment at these locations. The stormwater treatment plants for these areas would be collocated IPCT plants at these sites for economy and efficiency.

Implementation of this plan would produce impacts in varying degrees on the environment, resources, public health, the economy and the individuals in the area. Table 20 lists the significant impacts, identified by the evaluators, which may result from implementation of this plan. Each impact is indicated under the column which identifies the primary area affected. Other areas which would also be affected are identified and the relative degree of effect is also indicated.

Representative Plan 2

Representative Plan 2, as shown figures 14A and B, has both land irrigation and treatment plants in portions of the plan. Land irrigation techniques would be used in central Lenawee and southern St. Clair County for treatment of both stormwater and municipal-industrial wastewater from these areas. In each system the wastewater would be treated in aerated lagoons, disinfected, then irrigated on farmlands owned and managed by the operating agency. Sludge from the St. Clair and Lenawee County treatment lagoons would be applied to the land on adjacent sludge disposal sites.

The major portion of the region's wastewater would be treated by the common system described earlier in this section. Small communities outside of the regional service area would operate individual treatment plants until growth would warrant extension of the regional interceptors.

Implementation of this plan would produce impacts in varying degrees on the environment, resources, public health, the economy and the individuals in the area. Table 21 lists the significant impacts, identified by the evaluators, which may result from implementation of this plan. Each impact is indicated under the column which identifies the primary area

TABLE 21

REPRESENTATIVE PLAN TWO
IMPACT IDENTIFICATION TABLE

	THE IMMEDIATE VICINITY OF A WASTEWATER FACILITY	THE AREA IN SOUTHEASTERN MICHIGAN SERVED BY THE WASTEWATER SYSTEM	DIRECTLY AFFECTED AREAS OUTSIDE THE SERVICE AREA
I. WATER QUALITY			
A. SURFACE WATERS		Significant improvements could be expected in the water quality in the St. Clair, Clinton, Rouge, Huron, Detroit and Raisin Rivers due to elimination of urban stormwater and wastewater discharges.	
		Peak storm flows would be equalized in the Rouge, Huron and Clinton Rivers due to stormwater storage facilities.	
B. GROUNDWATER	An increase in stream baseflow may be experienced in areas under irrigation.		
	Some water from irrigated areas may reach ground waters but would only affect quantity not quality.		
	Ground water contamination could result from poorly managed sludge application areas and sludge landfills (primarily nitrates and heavy metals).		
II. AQUATIC LIFE AND WATERFOWL		Habitats for intolerant game fish would be improved; however, artificial stocking would be required to maintain populations.	
III. PUBLIC HEALTH		Pathogen contamination from treatment plant effluents and uncontrolled discharge of urban storm runoff and combined sewer overflow would be virtually eliminated.	
	Increased concentrations of pathogens could be expected in the air in the vicinity of AWT aeration basins, aerated lagoons, and irrigation activities.		
			Infections disease could be spread by waterfowl or other animals allowed access to stormwater storage lagoons, wastewater treatment and storage lagoons and wastewater conveyance ditches.
	A potential hazard would exist where large quantities of chlorine would be handled (On site chlorine production would significantly reduce the hazards).		
IV. ENERGY AND NATURAL RESOURCES A. AIR		Some gaseous (NO_x and SO_x) and particulate matter would be emmitted from incineration, lime sludge recalcination and carbon regeneration facilities at treatment plant sites.	
	A plume would be visible at incineration and lime sludge recalcination sites due to condensed water vapor.		
B. CHEMICALS		150,000 tons of chlorine (or raw materials, salt and electrical energy: 2600 kwhr/ton (Cl_2) would be consumed annually.	
		544,000 tons of lime (or raw materials, limestone rock and heat energy: 4.25-8.25 million BTU/ton lime) would be consumed annually.	

The comments in this table are intended to identify impacts only; each comment appears under the column identifying the area of greatest significance. The relative significance for other areas is identified by the screening indicated in the index to the right.

Equally Significant

Somewhat Significant

Partially Significant

Insignificant

THE REST OF THE STATE OF MICHIGAN	THE LAKE ERIE BASIN	THE NATION	CANADA - INTERNATIONAL
This plan would result in water of higher quality than presently required by the State of Michigan.		This plan meets the intent and time-phased goals of Public Law 92-500.	This plan would comply with the April 1972 agreement with Canada on Great Lakes water quality.
	There is little potential for significant improvement in the western half of Lake Erie with respect to algal blooms and oxygen depletion.		
	If similar wastewater management projects were carried out in the remainder of the Lake Erie basin, ecological recovery may be possible in the eastern half of the lake.		
	Although the habitat for intolerant fishes would be improved in Lake Erie, improvement of fisheries will depend on management practices in the commercial fishing industry.		
	Waterfowl populations may improve due to improved habitats and food supplies.		

TABLE 21

REPRESENTATIVE PLAN TWO
IMPACT IDENTIFICATION TABLE
(CONTINUED)

	THE IMMEDIATE VICINITY OF A WASTEWATER FACILITY	THE AREA IN SOUTHEASTERN MICHIGAN SERVED BY THE WASTEWATER SYSTEM	DIRECTLY AFFECTED AREAS OUTSIDE THE SERVICE AREA
B. CHEMICALS (Continued)		81,000 tons of methanol (brewers waste could be substituted) would be consumed annually.	
			Phosphorus and nitrogen in the irrigated wastewater would be recycled into the environment reducing the need for commercial fertilizers.
C. ELECTRICAL POWER		The average electrical power demand of 290 megawatts is within the planned capabilities of Detroit Edison.	
		The additional 1850 megawatts required for peak stormwater pumping would be met by stand-by generators which could also serve as emergency back-up to the regional power grid.	
D. FUEL OIL OR NATURAL GAS		33 billion BTU of heat energy from fuel oil or natural gas would be required daily.	
V. EMPLOYMENT		Labor demands for construction would cover a period of 10-12 years. The demands for that period would exceed the local supply thus requiring labor from outside the region.	
		Unemployment in the construction trades would be expected to drop with the advent of construction and increase upon completion of the project.	
		The total operating manpower required would be 3,197. Special training programs would be necessary to meet demands for technicians and specialty labor categories.	
VI. LAND AND WATER USE CHANGES		Essentially all of the proposed facilities would somewhat alter existing and proposed land use.	
		Buffer areas specified for most wastewater facilities have potential use by local units of government for open space or recreational areas.	
			Although an increase in gross productivity of the irrigated land could be expected, land removed from production for treatment and storage lagoons could result in no net increase in total production.
		Implementation of this plan would necessitate development of a supplementary water source for the Ann Arbor-Ypsilanti area to avoid abnormally low flows in the Huron River.	
	A potential would exist for developing local industrial water supplies utilizing renovated wastewater particularly in the vicinity of facilities near Adrian, Ypsilanti, Plymouth and the Huron River. Industrial expansion could thus be encouraged in areas previously not industrially oriented.		
VII. LAND VALUES		Land values along southeastern Michigan shorelines should increase due to improved water quality over the area and peak flow reduction in the Rouge and Clinton Rivers.	
	Some loss of property value may be experienced in the vicinity of wastewater management facilities due to the stigma associated with such facilities.		
			Forage type crops to be produced on lands under irrigation would displace any cash crops previously grown.
VIII. AREA ECONOMY AND INSTITUTIONS		The history of growing intergovernmental cooperation in southeastern Michigan lays the basis for a regional approach to wastewater management.	

THE REST OF THE STATE OF MICHIGAN	THE LAKE ERIE BASIN	THE NATION	CANADA — INTERNATIONAL

TABLE 21

REPRESENTATIVE PLAN TWO
IMPACT IDENTIFICATION TABLE
(CONTINUED)

	THE IMMEDIATE VICINITY OF A WASTEWATER FACILITY	THE AREA IN SOUTHEASTERN MICHIGAN SERVED BY THE WASTEWATER SYSTEM	DIRECTLY AFFECTED AREAS OUTSIDE THE SERVICE AREA
VIII. AREA ECONOMY AND INSTITUTIONS (Continued)		Implementation and operation of this alternative would require one or several management organizations having a number of comprehensive management capabilities (i.e. planning, financing, construction, operation, maintenance and administrative capabilities).	
		Implementation of this plan would be contrary to the goals of some communities, particularly Ann Arbor, Pontiac and Warren, which desire to maintain autonomy.	
		86,780 acres of land would be removed from the tax base of local and county governments.	
		All existing treatment facilities in the service area with the exception of Detroit, Wyandotte, Port Huron and Monroe would be phased out by 1985.	
		The regional economy would be stimulated temporarily due to demands for construction materials and increased construction payrolls.	
		Gross income in the area would increase due to increased wastewater system payrolls; however, there would be an area-wide decrease in disposable income of each family due to increased sewer charges to offset costs shown under X. below.	
		The creation of an unpolluted water supply would not have a significant effect on existing economic enterprizes, nor is it apt to attract new types of economic activity.	
			Replacement of small farms with the large commercial type operations could affect local distributional channels for machinery, seed, fertilizer, etc. in St. Clair and Lenawee Counties.
IX. SOCIO-ECONOMICS	Owners of economic establishments and residents of lands required for construction of wastewater facilities would have to be relocated.		
	Residents of lands near proposed facilities would have their normal lifestyle disrupted and commercial enterprizes near-by would be affected while construction operations were underway.		
		The system would help satisfy a regional need for expanded water based recreation by providing more waters suitable for total body contact recreation.	
X. SYSTEM COSTS:			
A. CAPITAL COSTS		$1,064,000,000	
B. AMORTIZED CAPITAL COST (Average annual)		63,000,000	
C. OPERATION AND MAINTENANCE (Average annual)		124,000,000	
D. TOTAL AVERAGE ANNUAL COST		187,000,000	

THE REST OF THE STATE OF MICHIGAN	THE LAKE ERIE BASIN	THE NATION	CANADA - INTERNATIONAL
		$3,193,000,000	
		188,000,000	
		188,000,000	

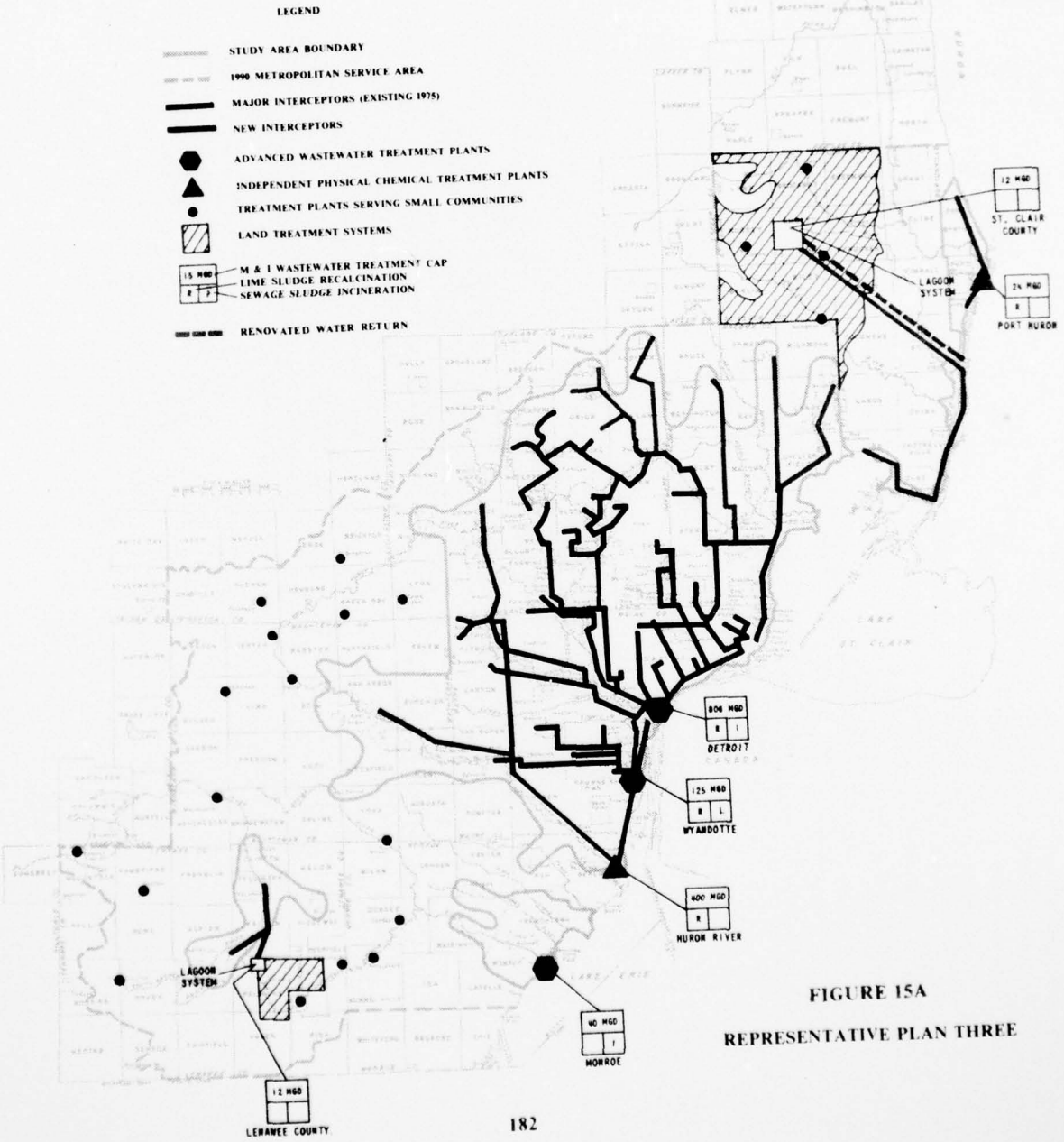

FIGURE 15A

REPRESENTATIVE PLAN THREE

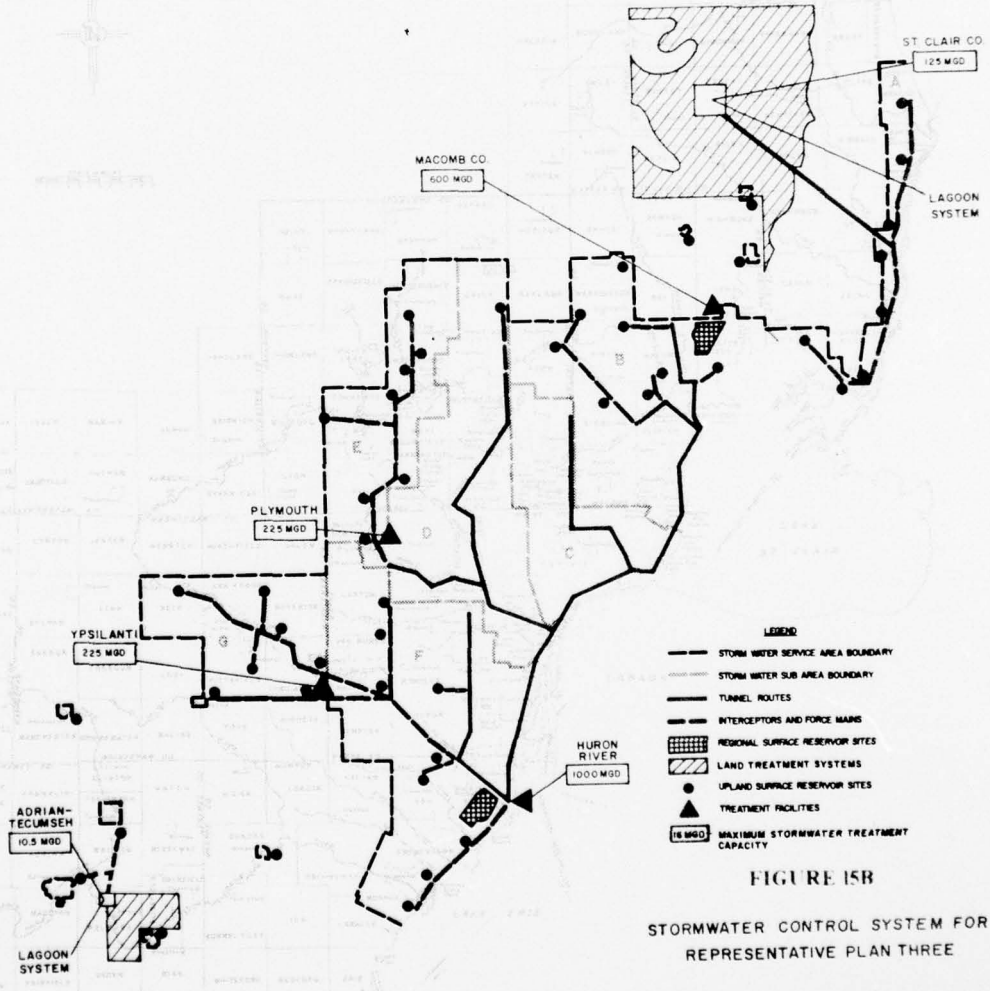

FIGURE 15B

STORMWATER CONTROL SYSTEM FOR REPRESENTATIVE PLAN THREE

affected. Other areas which would also be affected are identified and the relative degree of effect is also indicated.

Representative Plan 3

In Representative Plan 3, as shown figures 15A and B, the major portion of the region's wastewater would be treated in the plant system common to all plans. Land irrigation treatment would be employed for treating both municipal-industrial and stormwater in southern St. Clair County and central Lenawee County. In each system the wastewater would be treated in aerated lagoons, disinfected, and distributed to nearby farmers for irrigation on their land. This land would remain under the ownership and control of the individual farmer or land owner. Sludge from the treatment lagoons in St. Clair and Lenawee Counties would be applied to special sludge disposal sites adjacent to the lagoons. Small communities outside of the regional service area would operate individual treatment plants until growth would warrant extension of the regional interceptors.

Implementation of this plan would produce impacts in varying degrees on the environment, resources, public health, the economy and the individuals in the area. Table 22 lists the significant impacts, identified by the evaluators, which may result from implementation of this plan. Each impact is indicated under the column which identifies the primary area affected. Other areas which would also be affected are identified and the relative degree of effect is also indicated.

EVALUATION OF FINAL PLANS

Water Quality

Only the three representative plans would be capable of approaching the goal of "no discharge of pollutants" by 1985. The Interim Water Quality

TABLE 22

REPRESENTATIVE PLAN THREE
IMPACT IDENTIFICATION TABLE

	THE IMMEDIATE VICINITY OF A WASTEWATER FACILITY	THE AREA IN SOUTHEASTERN MICHIGAN SERVED BY THE WASTEWATER SYSTEM	DIRECTLY AFFECTED AREAS OUTSIDE THE SERVICE AREA
I. WATER QUALITY			
A. SURFACE WATERS		Significant improvements could be expected in the water quality in the St. Clair, Clinton, Rouge, Huron, Detroit and Raisin Rivers due to elimination of urban stormwater and wastewater discharges.	
		Peak storm flows would be equalized in the Rouge, Huron and Clinton Rivers due to stormwater storage facilities.	
B. GROUND WATER	An increase in stream baseflow may be experienced in areas under irrigation.		
	Some water from irrigated areas may reach ground waters but would only affect quantity not quality.		
	Ground water contamination could result from poorly managed sludge application areas and sludge landfills (primarily nitrates and heavy metals).		
II. AQUATIC LIFE AND WATERFOWL		Habitats for intolerant game fish would be improved; however, artificial stocking would be required to maintain populations.	
III. PUBLIC HEALTH		Pathogen contamination from treatment plant effluents and uncontrolled discharge of urban storm runoff and combined sewer overflow would be virtually eliminated.	
	Increased concentrations of pathogens could be expected in the air in the vicinity of AWT aeration basins, aerated lagoons, and irrigation activities.		
			The decentralized control in the land irrigation system proposed could result in more frequent ponding of wastewater and increased potential for mosquito breeding.
		Infectious disease could be spread by waterfowl or other animals allowed access to stormwater storage lagoons, wastewater treatment and storage lagoons and wastewater conveyance ditches.	
		Hygienists warn that direct consumption of crops grown on wastewater irrigated land may be dangerous due to incomplete disinfection prior to irrigation and potential crop uptake of harmful materials.	
	A potential hazard would exist where large quantities of chlorine would be handled (On site chlorine production would significantly reduce the hazards).		
IV. ENERGY AND NATURAL RESOURCES A. AIR		Some gaseous (NO_X and SO_X) and particulate matter would be emmitted from incineration, lime sludge recalcination and carbon regeneration facilities at treatment plant sites.	
	A plume would be visible at incineration and lime sludge recalcination sites due to condensed water vapor.		

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The comments in this table are intended to identify impacts only; each comment appears under the column identifying the area of greatest significance. The relative significance for other areas is identified by the screening indicated in the index to the right.

Equally Significant

Somewhat Significant

Partially Significant

Insignificant

THE REST OF THE STATE OF MICHIGAN	THE LAKE ERIE BASIN	THE NATION	CANADA - INTERNATIONAL
This plan would result in water of higher quality than presently required by the State of Michigan.		This plan meets the intent and time-phased goals of Public Law 92-500	This plan would comply with the April 1972 agreement with Canada on Great Lakes water quality.
	There is little potential for significant improvement in the western half of Lake Erie with respect to algal blooms and oxygen depletion.		
	If similar wastewater management projects were carried out in the remainder of the Lake Erie basin, ecological recovery may be possible in the eastern *half of the lake.*		
	Although the habitat for intolerant fishes would be improved in Lake Erie, improvement of fisheries will depend on management practices in the commercial fishing industry.		
	Waterfowl populations may improve due to improved habitats and food supplies.		

TABLE 22

REPRESENTATIVE PLAN THREE
IMPACT IDENTIFICATION TABLE
(CONTINUED)

	IN THE IMMEDIATE VICINITY OF A WASTEWATER FACILITY	IN THE AREA IN SOUTHEASTERN MICHIGAN SERVED BY THE WASTEWATER SYSTEM	IN DIRECTLY AFFECTED AREAS OUTSIDE THE SERVICE AREA
B. CHEMICALS		180,000 tons of chlorine (or raw materials, salt and electrical energy; 2600 kwhr/ton Cl_2) would be consumed annually.	
		844,000 tons of lime (or raw materials, limestone rock and heat energy; 4.25-8.25 million BTU / ton lime) would be consumed annually.	
		51,000 tons of methanol (brewery waste could be substituted) would be consumed annually.	
			Phosphorus and nitrogen in the irrigated wastewater would be recycled into the environment reducing the need for commercial fertilizers.
C. ELECTRICAL POWER		The average electrical power demand of 285 megawatts is within the planned capabilities of Detroit Edison.	
		The additional 1850 megawatts required for peak stormwater pumping would be met by stand-by generators which could also serve as emergency back-up to the regional power grid.	
D. FUEL OIL OR NATURAL GAS		33 billion BTU of heat energy from fuel oil or natural gas would be required daily.	
E. EMPLOYMENT		Labor demands for construction would cover a period of 10-12 years. The demands for that period would exceed the local supply thus requiring labor from outside the region.	
		Unemployment in the construction trades would be expected to drop with the advent of construction and increase upon completion of the project.	
		The total operating manpower required would be 1163. Special training programs would be necessary to meet demands for technicians and specialty labor categories.	
VI. LAND AND WATER USE CHANGES		Essentially all of the proposed facilities would somewhat alter existing and proposed land use.	
		Buffer areas specified for most wastewater facilities have potential use by local units of government for open space or recreational areas.	
			Those areas irrigating with wastewater should experience an increase in both useable agricultural land and average yields.
		Implementation of this plan would necessitate development of a supplementary water source for the Ann Arbor-Ypsilanti area to avoid abnormally low flows in the Huron River.	
	A potential would exist for developing local industrial water supplies utilizing renovated wastewater particularly in the vicinity of facilities near Adrian, Ypsilanti, Plymouth and the Huron River. Industrial expansion could thus be encouraged in areas previously not industrially oriented.		
VII. LAND VALUES		Land values along southeastern Michigan shorelines should increase due to improved water quality over the area and peak flow reduction in the Rouge and Clinton Rivers.	
	Some loss of property value may be experienced in the vicinity of wastewater management facilities due to the stigma associated with such facilities.		

THE REST OF THE STATE OF MICHIGAN	THE LAKE ERIE BASIN	THE NATION	CANADA - INTERNATIONAL

TABLE 22

REPRESENTATIVE PLAN THREE
IMPACT IDENTIFICATION TABLE
(CONTINUED)

	THE IMMEDIATE VICINITY OF A WASTEWATER FACILITY	THE AREA IN SOUTHEASTERN MICHIGAN SERVED BY THE WASTEWATER SYSTEM	DIRECTLY AFFECTED AREAS OUTSIDE THE SERVICE AREA
VIII. AREA ECONOMY AND INSTITUTIONS		The history of growing intergovernmental cooperation in southeastern Michigan lays the basis for a regional approach to wastewater management.	
		Implementation and operation of this alternative would require one of several management organizations having a number of comprehensive management capabilities (i.e. planning, financing, construction, operation, maintenance and administrative capabilities).	
		Implementation of this plan would be contrary to the goals of some communities, particularly Ann Arbor, Pontiac and Warren, which desire to maintain autonomy.	
		31,450 acres of land would be removed from the tax base of local and county governments.	
		All existing treatment facilities in the service area with the exception of Detroit, Wyandotte, Port Huron and Monroe would be phased out by 1985.	
		The regional economy would be stimulated temporarily due to demands for construction materials and increased construction payrolls.	
		Gross income in the area would increase due to increased wastewater system payrolls; however, there would be an area-wide decrease in disposable income of each family due to increased sewer charges to offset costs shown under X. below.	
		The creation of an unpolluted water supply would not have a significant effect on existing economic enterprizes, nor is it apt to attract new types of economic activity.	
IX. SOCIO-ECONOMICS	Owners of economic establishments and residents of lands required for construction of wastewater facilities would have to be relocated.		
	Residents of lands near proposed facilities would have their normal lifestyle disrupted and commercial enterprizes near-by would be affected while construction operations were underway.		
		The system would help satisfy a regional need for expanded water based recreation by providing more waters suitable for total body contact recreation.	
X. SYSTEM COSTS			
A. CAPITAL COSTS		$1,124,000,000	
B. AMORTIZED CAPITAL COST (Average annual)		66,000,000	
C. OPERATION AND MAINTENANCE (Average annual)		133,000,000	
D. TOTAL AVERAGE ANNUAL COST		199,000,000	

THE REST OF THE STATE OF MICHIGAN	THE LAKE ERIE BASIN	THE NATION	CANADA - INTERNATIONAL
		$3,374,000,000 199,000,000 199,000,000	

Plan could achieve the 1983 objectives. The water quality objectives of the State of Michigan and the objectives outlined in the April, 1972 agreement between the United States and Canada on Great Lakes water quality could be met by each of the four plans.

Implementation of any one of the four plans would result in significant improvements in the water quality of the inland rivers. The centralization of treatment facilities along the St. Clair and Detroit Rivers and Lake Erie would reduce the number of inland wastewater and combined sewer overflow discharges. Inland river water quality is expected to be higher for the Representative Plans than for the Interim Plan since urban storm runoff from separately sewered areas is addressed in the former. Each of the Representative Plans results is essentially the same inland river water quality.

Although the Interim Plan may have some effect on improving water quality in the Lake, algae related problems would not be affected and improvement to the Lake may not be obvious. If any of the three Representative Plans were implemented, algae related problems in the eastern half of the Lake should be reduced. Improvement of the western half of the Lake would only be realized over a period of many years if at all.

Aquatic Life and Waterfowl

Effects of implementation of one of the plans on aquatic life habitats would closely parallel the improvement in water quality. Fisheries improvement is also dependent on artificial stocking of inland rivers and management of fisheries in Lake Erie. Improved water quality and aquatic life habitats would also have positive effects on waterfowl.

Public Health

Restrictions placed on recreational use of southeastern Michigan surface waters are primarily caused by contamination by pathogens (bacteria

and virus) from partially treated wastewater discharges and combined storm and sanitary sewer overflows. Since all four plans place emphasis on eliminating sources of pathogen contamination, implementation of any of the plans would result in increased potential for recreational development of southeastern Michigan surface waters. Conditions would be somewhat better if one of the three representative plans were implemented since disinfection measures would be much more efficient and more stormwater treatment would be employed.

It would be difficult to identify the degree of impact that would be realized from other considerations such as aerosols, downwind of treatment facilities, chlorine hazards, incineration by-products, or disease transmission by waterfowl and wild game. Further study would be required into both engineering methods to avoid the problems and the expected severity of the problems. The basic feelings of the evaluators, however, were that until substantial data was available on land irrigation, wastewater treatment plants would be preferred and human consumption of crops grown on irrigated lands should be discouraged. This would indicate that with present knowledge, Representative Plan One would be preferred followed by Two and Three.

Energy and Natural Resources

There is little difference in demands placed on energy (electrical and fuel), chemicals or the atmosphere by the Representative Plans. The Interim Plan, can be expected to have roughly half the demands for chemicals and energy estimated for the Representative Plans. The primary concern should be focused on energy requirements since the major resource consumed in manufacturing both lime and chlorine would be energy.

Employment

Each of the plans could be implemented within the time frame dictated by the law, if an intensive program of construction was undertaken. This would result in excessive demands both for direct construction labor

and labor which would be required for equipment fabrication and related fields. A question has been raised as to whether an area-wide demand for labor, materials and equipment could be met. Construction labor demands would be greatest for the Representative Plans and somewhat less for the Interim Plan.

Operating labor demands would not be excessive for any of the plans. The skill level of the wastewater treatment plant operators would have to be higher than in the past since operations at the plants are becoming more complex. The requirements could be met by instituting training programs far enough in advance of the need.

Land and Water Use Changes

Of the four plans, the Interim Plan would cause the least change in existing and proposed land use. The primary changes would be due to location of stormwater storage facilities and location of the new Huron River treatment plant. The three Representative Plans share many common facilities and would for the most part have similar impacts on land use. The primary impacts would be a result of location of stormwater storage facilities throughout the service area. Expansion of existing wastewater treatment plants in Detroit and Wyandotte would require displacement of land now in high density residential use.

The Representative Plans differ in the methods of handling wastewater in St. Clair and Lenawee Counties. In Plan One, 80 acres would be required in East China and 20 acres would be required in the Adrian area for wastewater-stormwater treatment plants. In Plans Two and Three, there would be no plants in the East China or Adrian areas; however, agricultural land in both St. Clair and Lenawee Counties would be affected. For both plans 41,120 and 590 acres, respectively, would be required for treatment and storage lagoons in St. Clair and Lenawee Counties. That would probably displace land in agricultural use. An additional 1,059 and 450 acres, respectively, of agricultural land would be devoted to sludge disposal and

forage crop production. In Plan two, 18,600 acres in St. Clair County and 3,900 acres in Lenawee County would be used for irrigation of wastewater. Although the land would be maintained in agricultural use, crops would be restricted to forage type and control of the land would rest with the managing agency. In Plan Three, 53,600 acres in St. Clair County and 16,850 acres in Lenawee County would be irrigated; however, crop types would not be restricted and control would rest with the individual farmer.

Each of the plans offers opportunities for expanded recreation and open space development in the vicinity of new wastewater facilities. Improved water quality would also contribute to development of recreation. The degree of development of opportunities would have to be the choice of the implementing agency or the local governmental unit.

The discussion of water reuse presented in Chapter VII under Land and Water Use Changes also applies to the Representative Plans. Those comments refered primarily to development of industrial water sources.

Land Values

Changes in land values as a result of plan implementation would be due to improved water qualtiy or proximity of wastewater facilities. Land values could be expected to increase along shorelines and in the vicinity of developed recreational areas. Some decrease in values could be expected due to odor problems or the general stigma associated with wastewater. No general comparison between plans would be feasible since these effects would be local in nature.

Area Economy and Institutions

A sound basis exists for regional wastewater mangement in southeastern Michigan. The most severe problem to be encountered in implementing one of the plans would be the acquisition of land required for stormwater storage and wastewater treatment facilities. Resistance from communities

forced to abandon existing treatment plants would also pose problems.

Another problem for local governmental units would be the loss of land from tax rolls. This could be a significant factor in selection of a method of treatment in St. Clair County since Plan One would require 80 acres, Plan Two 23,800 acres and Plan Three 5,200 acres.

The construction program associated with implementation of one of the plans would have a significant effect on the local economy through increased payrolls, increased demand for construction materials and machinery, and secondary economic effects. Costs to individual families for wastewater treatment would increase since the local share of the construction cost and operation and maintenance costs would be paid through user charges. Impacts would be greater for the Representative Plans than for the Interim Plan.

With the exception of the reuse potentials discussed earlier, there should be no direct effect of expanded wastewater treatment on existing economic enterprises.

Socio-Economics

Implementation of any plan of this magnitude would require displacement of individuals who occupy the affected land. Depending upon the individuals and how the displacement is handled, the overall impact could be positive or negative. No precise data was developed giving the number of families affected by each proposed facility so there are no numerical comparisons of the effects of implementing each alternative. Some degree of comparison can be made based on the amount of land required for each plan.

A positive social effect would result from expansion of open space and recreational development. The degree of development, as previously pointed out, would depend on local units of government.

System Costs

In the impact tables system costs are divided into costs to the Southeastern Michigan region and Federally funded costs. The following is a summary of annual costs based on 5-1/2 percent over 50 years.

	Annual Cost to Southeastern Michigan $ Million	Annual Cost To Nation $ Million	Total Annual Cost $ Million
INTERIM WATER QUALITY PLAN	56.0	97.0	153.0
REPRESENTATIVE PLAN ONE	185.5	185.0	370.5
REPRESENTATIVE PLAN TWO	186.0	187.0	373.0
REPRESENTATIVE PLAN THREE	195.0	194.0	389.0

It is obvious that there is a distinct cost difference between the Interim Plan and the three Representative Plans; however, there is no significant difference in total cost between the Representative Plans. When comparing the Representative Plans on a cost basis, the cost differential becomes more obvious when examined for the service areas in St. Clair County and Lenawee County.